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EXPLANATION OF THE PLATES.

ERRATA.

TRANSACTIONS.—Page 113, line two from the bottom of the page, for "Japan" read "Java"; p. 218, l. 6, for *eucrema* read *eucrena;* p. 220, lines 1 and 29, for *Scoparia* read *Scopula;* p. 279 (No. 84), for *euptychiodes* read *euptychioides;* p. 286 and elsewhere, for *horsfeldi* read *horsfieldi* throughout; p. 290, No. 365 (middle column), for *verhueli* read *verhuelli;* p. 292, No. 425, for *Leptocireus* read *Leptocircus;* p. 297, l. 27, for *Stictopthalma* read *Stictophthalmia;* p. 333, Nos. 91 and 92, for *Stictopthalma* read *Stictophthalmia;* p. 467, for *cheaspes* read *choaspes*, and for *luciptena* read *luciplena;* p. 471, for *cheaspes* read *choaspes*, and for *luciptena* read *luciplena;* p. 606, for *kilhmiella* read *kühniella*

PROCEEDINGS.—Page xiv, line 16, for "upper section of the triangle" read "upper sector of the triangle."

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1888 YERBURY, Major J. W., R.A., *The Army and Navy Club*, *Pall Mall*, S.W.; and *Mount Wise*, *Devonport*.

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THE

TRANSACTIONS

OF THE

ENTOMOLOGICAL SOCIETY

OF

LONDON

For the Year 1888.

I. *Notes on the life-history of various species of the Neuropterous genus* Ascalaphus. By J. O. Westwood, M.A., F.L.S., Life-President of the Ent. Soc. Lond., &c.

[Read October 5th, 1887.]

Plates I. & II.

I am again indebted to my excellent correspondent, J. Staniforth Green, Esq., of Colombo, Ceylon, for the chief materials of the present communication concerning the natural history of a Ceylonese species of the interesting genus *Ascalaphus*, to which I have thought it useful to prefix such observations on the subject as have hitherto been published.

Bonnet (Observ. s. les insectes, T. ii., pp. 282—289) informs us that he discovered, in the environs of Geneva, two specimens of a larva which differed from the ordinary ant-lion in not crawling backwards, and in not forming a pit-fall, with the body considerably longer and more pointed, and the hind legs affixed so as not to be so completely concealed beneath the body, which

was terminated by a single "demi-couronne de poils courts un nombre de huit (pl. vi., fig. 8)."

Reaumur (H. n. Ins., Tom. vi., p. 377, pl. 33, figs. 11 and 12, in which he gives copies of Bonnet's figures) describes some of the characters of the ordinary ant-lion, and of the species described by Bonnet (with whom he was in correspondence), especially in respect to the terminal segments of the body and their appendages (pl. vi., figs. 4—9).

Latreille (H. n. Crust. et ins., xiii., p. 26; and Nouv. Dict. d. h. n., T. ii., p. 581) considers it probable that the larvæ found by Bonnet belonged to a species of *Ascalaphus* rather than to *Myrmeleon*.

Burmeister also (Hdb. d. Ent., bd. ii., abth. iii., p. 1003) gives Bonnet's larva as that of *Ascalaphus italicus*.

Shuckard concisely described the larva of *Ascalaphus* as being considerably like that of *Myrmeleon*, but not making conical traps, and as having a forward and not backward progression (Cabinet Cyclop. Nat. Hist., Insects, p. 340.

From the account given by the Rev. L. Guilding of the larva of *A. Macleayanus*, noticed below, and from more recent accounts recorded of the habits of certain Myrmeleonides, it appears to me that Bonnet's larva was more probably that of *M. libelluloides*, or an allied species, agreeing in some respects with the larva of that insect described by "Ionicus" in the 'Entomological Magazine' (vol. iii., p. 461), and which he states generally feeds on heteromerous beetles, lurking underground in the sand, without making a pit.

The Rev. Lansdown Guilding published a figure and description of a new species of *Ascalaphus* (*A. Macleayanus*) from St. Vincent's (W. Indies) in the 14th volume of the 'Transactions' of the Linnean Society (p. 140), of which he observes that the eggs are "oblonga, cinerascentia, gregatim posita"; but that the "larva pupaque latent" (March 10th, 1823).

On June 16th, 1826, he forwarded a further communication to the same Society (*ibid.*, vol. xv., p. 509), containing various additions to and corrections of several of his former papers, and adding to the description of the genus *Ascalaphus* the following:—

"*Ova* cute pergemenea tecta. *Larva* complanata,

lateribus pectinatis, pedibus omnibus gressoriis, mandibulis elongatis, curvis, tubulosis, apice perforatis; ano stylato, stylo colifero. Dolo prædam captans. *Pupa* folliculata, folliculo rotundato."

"Animal insectivorum, sæpe die quiescit, in arbustis vetustis emortuis, cum antennis alisque ramo applicatis abdomineque (in more ramuli) extenso, sic hostes decipiens. *Ova* numero 64—75 lanceolato-elliptica cinerascentia, apicibus puncto candido, in extremitate ramulorum ponit imago; serie duplici alternatim agglutinans et circulis multis *repagulorum* ab hostibus defendens. *Repagula* elongata, pedunculata subdiaphana, rufescentia. *Larva* caput subcordatum, fuscum genis barbatis superne scabrum. *Os* nullum. *Mandibulæ* castaneæ validæ, elongatæ, interne trispinosæ. *Oculi* supra sex, infra unicus, in *pedunculo* communi, crasso, postice bisetoso antice appendiculato. *Antennulæ ?* quatuor setiformes; palpi duo filiformes. *Thorax* parvulus subovatus, supra utrinque spinula brevi mobili maculisque duabus nigris. *Abdomen* ovale, complanatum scabrum, flavescens, livido irroratum maculis quatuor anterioribus, duabus analibus, lineâque dorsali nigris; subtus fere concolor. *Pectines* utrinque decem, atro ciliati (anticis duobus (alarum rudimentis ?) curvis. *Pedes* nigri spinulosi, duo anteriores thoracici. *Ungues* parvi, omnes simplices. *Tracheæ* parvæ nigræ.

"*Larva* segnis corpus pectinesque arenulis tegens, mandibulisque sub lateribus reconditis prædam expectans. *Pullus* capite majori. *Pupa* corpus flavescens, curvum obesum lanuginosum; abdomine livido irrorato lateribus prominulis bullatis, linea dorsali nigra. *Caput* hirsutum. *Mandibulæ* ferrugineæ. *Antennæ* supra oculos ad pectus reflexa capitulo evanido. *Oculi* nigricantes bilobati. *Folliculus* arenulis colo anali mire convexus cuteque pellucido intus tectus."

Figures of the eggs, repagula, and larvæ accompanied Mr. Guilding's communication, but have never been published.

By the term *repagula* (barriers) Mr. L. Guilding designated certain attendants on the eggs, which he conceived to be without analogies in the animal kingdom. "They are curiously placed in circles, and always on the extremity of a branch, so that nothing can approach the brood; nor can the young ramble abroad

till they have acquired strength to resist the ants and other insect enemies. The female may be seen expelling from her ovary these natural bodies with as much care as her real eggs."

The figures which Mr. Guilding sent to the Linnean Society in illustration of the history of this curious insect were not published, but Mr. Swainson gave a copy of the figure of the larva in his volume of the 'Cabinet Cyclopedia of Natural History' ("Habits and Instincts of Animals," p. 29), which represents the under side of the creature, with nine pairs of elongate conic setose appendages on each side of the body, accompanied by seven pairs of minute circular spiracles beneath the lateral appendages. Being represented from below the figure does not show the deeply emarginate hind part of the head.

A very minute specimen of Mr. L. Guilding's larva of *A. Macleayanus* is amongst Mr. Hope's Neuroptera, but it is completely covered with gum so as not to be intelligibly examined.

In my 'Introduction to Mod. Class. of Insects' (vol. ii., p. 41) I figured, also from the collection of the Rev. F. W. Hope, a larva (now in the Oxford Museum), which I believed, and which is now proved, to be the larva of an *Ascalaphus*, and which Dr. H. Hagen considers to belong to the subgenus *Haplogenius*. The head is very flat, deeply emarginate behind, and the body is furnished with twelve setose appendages on each side. No locality is attached to the specimen.

In the Bulletin of the Entomol. Soc. France, 1846, p. cxv., M. Guérin-Méneville stated that the larva of *A. longicornis* does not make a pitfall; that it hides itself under small stones, whence it seizes flies and other insects, on which it exclusively feeds, by means of its pierced mandibles, with which it sucks the fluid parts of its victims, and then abandons their dried and shrivelled-up skins.

M. Ragonot (Ann. Soc. Ent. France, 1878, 5 ser., t. xiii., Bull. Ent., p. cxx.) announced the discovery, at Lardy, on a twig of grass, of two rows of eggs, at first supposed to be Hemipterous, but subsequently proved by Mr. M'Lachlan to be those producing the larvæ of *A. longicornis* (see Trans. Ent. Soc. Lond., 1878, Proc., p. 50.

An excellent memoir on the transformations of *Ascalaphus macaronius*, Scop. (*A. hungaricus*, Rambur) and *Myrmeleon tetragrammicus*, by Dr. F. Brauer, was published in the 'Proceedings' of the k. k. Zoologisch-Botanischen Gesellschaft in Wien, vol. iv. (1854), p. 462, with three plates, the first of which is devoted to the internal anatomy of the imago of the *Ascalaphus*, the second to the illustration of the transformations, and the third to the larva of *Myrmeleon tetragrammicus* and *M.* (*Palpares*) *libelluloides*. The female of the *Ascalaphus* lays from forty to fifty eggs in two parallel rows on a twig at the end of July. The eggs are about a millimetre long, and are deposited so that their longitudinal diameter is nearly horizontal. They are of an oval form, and of a reddish yellow colour, with a dark ring near the broadest end (fig. 3, copied from Brauer). It is in the direction of this ring that the embryo larva makes its escape, the head being thrown backwards and lying upon the back. The body of the very young larva is nearly circular, serrated laterally, the head before hatching lying on its breast, but subsequently porrected; each of the mandibles is armed, besides the three ordinary teeth common to the larvæ of the family, on each edge with five or six obtuse points, nearly equal in length to the width of the jaw, each arising from a small lateral tubercle; each palpus arises from a large oval basal joint, followed by three smaller joints, and furnished with several (four) strong setæ, dilated at the end, similar to the setæ arising among the ocelli, of which there are six on each side resting on a short peduncular process. The mesothoracic segment is twice the width of the prothorax, with each of its lateral angles produced into a projecting setose point; and there are twelve lateral setose tubercles extending along each side of the body, the extremity of which is semi-oval or conic-ovate, and armed laterally with curved obtuse setæ. The upper surface of the abdominal segments is marked with small black spots (about fourteen on each, ten of them being disposed in transverse rows across the joints).

In the third of his plates Dr. Brauer has figured a larva of *Myrmeleon* as that of *M. tetragrammicus*, Pall., which he regards as identical with the species described by Bonnet and figured by Reaumur, which had been

considered by Latreille as the larva of an *Ascalaphus.* It has the hind division of the prothoracic segment terminating laterally in two horny points, projecting laterally and scarcely wider than the hind part of the fore division; there are twelve fascicles of setæ along each side of the remainder of the body, which is terminated in a semioval joint, armed at its extremity with eight short black horny points arranged in two groups, four in each.

In the same plate Dr. Brauer has figured another *Myrmeleon* larva as that of *M.* (*Palpares*) *libelluloides,* which is represented as destitute of setæ all over and round the body, which is terminated by two horny conical points, which are preceded by two still smaller points at the extremity of the preceding segment.*

In the fifth volume of the same work of the Zool.-Botan. Society of Vienna (1855, p. 479, with plate), Dr. Brauer has given a careful description and figure of the pupa of *A. macaronius,* Scop. (*A. hungaricus,* Rambur), and of its cocoon, and also of the mouth of the imago immediately on quitting the cocoon before the antennæ are grown to their natural length, and without the terminal knob by which they are subsequently distinguished.

In 1871 Mr. M'Lachlan communicated a memoir of "an attempt towards a systematic Classification of the Family *Ascalaphidæ,*" published in the Journal of the Linnean Society, Zoology, vol. xi., 1873, pp. 219—276, in the introductory part of which he reviewed the labours of his predecessors, Burmeister, Lefebvre, Rambur, myself, Walker, Hagen, and Brauer, both as to the systematic, as well as the biological, history of the group and its species, and has described two larvæ, one from Saugor, Central India, given to him by Mr. F. Moore, and the other from the Amazon Region, possibly that of a species of the genus *Ulula.*

In 1873 Dr. H. Hagen published† a memoir of con-

* The variations in the armature of the terminal segment of the larvæ serve to characterise, so far as hitherto known, the subgenera into which *Myrmeleon* has been divided. See Redtenbacher's Übersicht d. Myrmeleoniden-larven, published in the 48th vol. of the Denkschriften d. Kaiserl. Akad. d. Wissenschaften of Vienna, 1884, 4to, with seven plates, containing representations of twenty-five different larvæ of the ant-lions.

† 'Stettiner Entomologische Zeitung,' Jahrg. 34, 1873, 33.

siderable extent, in which notices are given of the larvæ of eighteen different species of Ascalaphides, which he has divided into eight genera founded on the relative position of the abdominal spiracles and lobes, the size of the teeth of the mandibles, the form of the head, the form of the ocular peduncles, the labrum, and the palpi. They are named:—1, *Haplogenius*; 2, *Ulula*; 3, *Suphalasca*; 4, *Helicomitus*; 5, *Glyptobasis*; 6, *Hybris*; 7, *Thelrproctophylla*; 8, *Puer*; 9, *Ascalaphus*; 10, a section termed *Holophthalmi*. The species of which the larvæ are described are:—1, *Ascalaphus macaronius*, Scop.; 2, *A. coccajus*, Schifferm.; 3, *A. longicornis*, L.; 4, *Puer maculatus*, Oliv.; 5, *Theleproctophylla barbara*, L.; 6, *Hybris subjacens*, Walk.; 7, *Suphalasca Dietrichiæ?* or *subtrahens?*; 8, *Helicomitus ?* sp.; 9, *Glyptobasis incusans* or *Ascalaphus cervinus*, Ceylon, from Neitner; 10, *Ulula Macleayana*, L. Guild.; 11, *U. senex*, Burm.; 12, *Ulula* sp., an *aurifera*, M'Lach.; 13 and 14, *Haplogenius* spec.?; 15, *Haplogenius* sp.; 16, *Haplogenius* ?. Unfortunately no figures are given either of the larvæ or entire insects or of their characteristic details.

In Mr. M'Lachlan's classification of the family *Ascalaphidæ*, published in the Journal of the Linnean Society, vol. xi., p. 219, 104 species of the family are arranged under 27 genera, of which 8 were proposed by Mons. A. Lefebvre in his memoir on the classification of the subfamily in the 'Magasin de Zoologie' for 1842.

Eight new species of Ascalaphides are described by Dr. Gerstaecker, in the 16th annual volume of the Mittheil. d. Naturw. Vereins Neuvorpomm. u. Rugen for 1884, belonging to the genera *Haploglenius* (from Upper Amazons), *Ulula* (Chiriqui, two species), *Suphalasca* (Cameroons, two species), *Dicolops*, n. g. (Cameroons), and *Ascalaphus* (Amur and Asia Minor).

The following is Mr. Staniforth Green's account of the economy of the Ceylonese species, which he has forwarded to me with specimens illustrating the history of the insect in question:—

"I wish to call your attention to the larva of an *Ascalaphus* after its first moult. I found it alive about the middle of last April with about thirty others on the stem of a small lily growing in a pot in my garden; they were all lying in a long straight row, overlapping

each other, and with only their heads and widely-opened mandibles free, and underneath them the empty egg-shells, from which they had emerged: these latter are curiously shaped." It is unfortunate that my correspondent had mislaid the sprig of the plant on which the insects were found, as, in a subsequent communication, he observes that he well remembers that the young larvæ were lying on the top of a white substance, similar to what is called by the Rev. L. Guilding "circulis multis repagulorum" in the case of the larvæ of *A. macleayanus*, of which, however, he gave no figure. "I placed them in a small glass box, and watched their habits for some weeks until they became perfect insects. I fed them at first on small gnats, and when they were larger on house and other flies. They scarcely ever moved from one position, lying close to and even over one another, and they waited until the flies walked into their widely-opened mandibles, when they would catch them with a quick sudden snap; when once received in that way there was no escape for the poor fly. In some twenty seconds it was quite dead, which led me to think that some poison was injected into the wound. The mandibles penetrated very deep and made two clean holes, plainly visible under the microscope after the insect had been sucked dry and empty. They showed no cannibal propensities except in one solitary instance, when one of them was seized by another and sucked empty, probably by mistake. After the third moult they obtained their full size, and remained in that condition for about ten days, when they became restless and wandered about seeking for a convenient situation in which to undergo the change to the perfect insect. I had placed sand at the bottom of the box, but they never burrowed into it. I placed one of the restless ones in a wine-glass half filled with fine sandy earth. It soon began to spin an arched cell, the web proceeding from a long flexible ovipositor-looking instrument, which, when not in use, lies concealed, sting-like, in the abdomen. As the work proceeded the creature threw sand over the web, which was within easy reach. This went on for some days, when the work was finished, and I saw no more of the insect until it emerged from its cocoon a four-winged fly in a fortnight's time. In its larval state it is a most voracious creature, but I do not

suppose that when relying on its own resources, a free insect, it obtains so abundant a supply of food as when well fed in confinement. I looked for but never found any traces of excremental matter.

"The larvæ first cast their skins on the 4th May, and others effected the change a day or so later. The second moult commenced on the 17th May, and on the 1st June one of them commenced to spin its cocoon, which it completed on the 3rd June. The first one to spin came out of its cocoon on the 23rd June. The full-grown larva measures seven-tenths of an inch from the end of the closed mandibles to the extremity of the abdomen, and the length of the body from the shoulder four-tenths of an inch. The colour is dull brown, with three longitudinal darker stripes down the abdomen, and a row of six dark spots down the under side of the abdomen. In life the head lies very flat and capable of considerable motion in all directions. In casting their skins they first got their heads out. Immediately after the change their mandibles appeared to be small and soft, but they enlarged and hardened very quickly; this would be necessary to enable them to disengage the teeeh from the old mandible-sheath."

The insect here described from Ceylon appears to me to agree with *A. insimulans*, Walker, described (Cat. Neuropt. Brit. Mus., pt. 2, p. 428) as a native of N. India. It is placed in the genus *Helicomitus* by Mr. M'Lachlan (Proc. Linn. Soc., xi., p. 261).

Dr. Hagen states that he had received three species of Ascalaphides from Colombo, *Glyptobasis incusans?*, *Ascalaphus cervinus?*, and *Hybris flavicans*; and Mr. M'Lachlan has described a larva, supposed to be that of the genus *Ulula*, in the Journal of the Linnean Society of London, T. xi., p. 225.

Explanation of Plates I. & II.

Fig. 1 represents a blade of grass with the eggs of *Ascalaphus hungaricus* arranged in two longitudinal series, twenty-six in each, for which I am indebted to Dr. Brauer, of Vienna. Many of these eggs have a semioval aperture on the outside of the row, from which

in many there depends a pointed portion of the egg-cover (fig. 2), although it is evident, from Dr. Brauer's figure of a separate egg and his description, that the young larva escapes by detaching a cap at one end of the egg (fig. 3). I am unable to explain the cause of the lateral aperture and detached portion of the egg-cover.

Fig. 4 represents a group of young larvæ of the Ceylonese species from a sketch by Mr. S. Green, representing a row of the insects sitting along a twig close behind one another, with the jaws widely expanded.

Fig. 5 represents a very minute larva found in the bottle of spirits which contained the full-grown larvæ and imagos. It is represented much magnified in fig. 6, showing the very large head, very short prothorax, nearly circular body. The front of the head is emarginate in the middle, with a row of short clavate setæ along the edge. The antennæ (fig. 7) are filiform and consist of about twenty-two joints, the basal ones of large size, and the apical one slender and much longer than the penultimate one. The ocelli are six on each side of the head, placed in a circle upon a strong projecting peduncle. There are twelve projecting setose lobes on each side of the hind segments of the thorax and abdomen. The setæ, which are thickened to the tips, arising from dilated portions of integument in a curious manner, are represented in the different figures 8 to 12, drawn under a high power.

Fig. 13 represents the full-grown larva, 7½ lines long, exclusive of the jaws. The head is deeply emarginate both anteriorly and posteriorly; it is depressed, finely setose, or villose. The antennæ (fig. 15) are very slender, except the two basal joints, and they are 15-jointed, the last joint very slender, with apparently a very minute terminal articulation, which bears three short setæ at its tip. Fig. 14 represents the side of the front portion of the head, which bears the ocelli, having a row of marginal setæ before the ocellar peduncle, the setæ being thickened at the tips. Fig. 16 represents one of the legs, of which the coxæ are long and cylindrical, giving much liberty of motion to the limb; the tarsus is composed of a single point, having two nearly straight ungues at its tip. The body is smooth, finely villose, destitute of the flattened lateral lobes seen

in the young larvæ, the sides of each of the meso- and metathoracic and abdominal segments having a tubercle thickly set with short bristles; of these there are twelve pairs, and below each of seven of the abdominal ones is a very minute black dot (fig. 17), representing a spiracle. The terminal segment of the abdomen (fig. 18) is elongate, subovate, setose, and armed at its apex with two groups of four small conical horny points. The mouth of the larva is of a very unusual structure, of the lower portions of which, in fact, I remember no other similar instance. The large sickle-shaped mandibles are armed with three strong spines on the inner edge, and are grooved along the whole of their length on the under side, within which groove the maxilla (fig. 19) works, having a dilated base; it is very slender, slightly dilated near the apex, curved so as to lie within the groove of the mandibles, and finely serrated within its inner edge (figs. 20, 21). Fig. 22 represents the lower lip and its appendages; the labium itself is very small and cup-shaped, with the centre of the front margin slightly porrected, the basal joint of the labial palpus, arising at the side of the produced part, dilated and curved so as to give support to the large setose oval joint (rather pointed at its tip), the three slender terminal joints springing from the extremity of the second joint. On either side of the labium there is attached a large movable plate of complex form (which might be possibly supposed to represent theoretically the maxillary palpi); The left-hand piece of this appendage is figured of a larger size in fig. 23, showing the deep notch in the middle of its fore edge, and the curious arrangement of setæ and spines with which it is furnished.

Fig. 24 represents the globular cocoon, formed of very fine membrane, to the outside of which particles of sand are attached; and fig. 25 represents it opened, showing the head and upper part of the body of enclosed pupa. Fig. 26 represents the pupa taken out of the cocoon, seen laterally. The eye is divided into two portions by a transverse sulcus; the antennæ are short, not knobbed, curved round the sides of the head, the terminal portion with the joints very short: the four rudimental wings lie at the sides of the body. In fig. 27 the pupa has the body more extended; and fig. 28 shows the mandibles of the pupa, each armed with nine minute sharp teeth,

totally differing from the mandibles either of the larva or imago, and given to the pupa only for the purpose of biting its way out of the cocoon.

The perfect insect (fig. 29) measures nearly an inch (11 lines) in length, and 2¼ in. in the expanse of its fore wings. It is of a fulvous colour; the thorax more yellow, with two darker discoidal spots; the scutellum is pale yellow; the antennæ are fulvous, with black tips; the wings are hyaline and colourless, with a very pale yellow stigma (fig. 35). The mandibles of the imago (fig. 30) are conical, rather dilated, and toothed on the inner edge at the base, the tip bent and acute. The maxillæ (figs. 31, 32) are bilobed, the outer lobes slender and curved, with curved setæ along the inner edge; the base of the inner lobe with a brush of long slender hairs; the maxillary palpi 5-jointed, the middle joint being the longest and subclavate. The labrum (fig. 32) is elongate-ovate, slightly bilobed at its anterior extremity; the labial palpi slender, 4-jointed, the two basal joints short. The abdomen of the male (fig. 33, seen sideways) is long, with the four terminal joints slender, the preceding segment with two fascicles of erect hairs; the apex of the body obtuse, without any exserted lobes; the terminal segment of the male is shown from above in fig. 34.

II. *A Synopsis of British* Homoptera-Cicadina. Part II. By James Edwards, F.E.S.

[Read October 5th, 1887.]

Plate III.

XII. TETTIGONIDÆ.

Frons and clypeus very convex, the passage from the former to the crown widely rounded. Thighs with a pair of spines on the upper side at the apex.

The British species of this family constitute a well-marked group, combining the tumid frons of the *Cercopidæ* with the multispinose tibiæ of the *Acocephalidæ* and following families. The affinities of the group under consideration will be best appreciated on a comparison of the structure of the head in *Evacanthus* and *Philænus*; the structure of the frons and the ridge dividing the crown from the face is very similar in these genera, while the situation of the ocelli and the multispinose tibiæ of the former indicate an approach to *Acocephalus.* Our two genera may be thus distinguished:—

Frons longitudinally carinate	i. Evacanthus.
Frons non-carinate	ii. Tettigonia.

i. Evacanthus, *Lep. et Serv.* (Pl. III., fig. 1).

Lep. et Serv., Enc. Méth., x., 612 (1825).

Upper side pubescent. Ocelli just beyond the eyes three or four times as far from each other as from the sides of the crown. The latter with an anchor-shaped keel, crossed about its apical third by a more or less distinct straight ridge, which runs from one ocellus to the other; on each side at the base a callus or a short outwardly oblique keel. Scutellum with a transverse impressed line before the apex, and two punctures near the base. Submarginal wing-nerve reaching the costa.

The two species of this genus are distinguished as follows :—

Clavus deep black, its inner margin widely yellow	1. *interruptus.*
Clavus brown, with thick whitish nerves	2. *acuminatus.*

1. *Evacanthus interruptus*, L.

Cicada interrupta, Linn., Faun. Suec., ed. ii., 241, 889; Fall., Hem. Suec., ii., 28, 5; Zett., Ins. Lapp., 289, 2.
Amblycephalus interruptus, Curt., Brit. Ent., 572, 2.
Evacanthus interruptus, Burm., Handb., ii., 116, 2; Flor, Rhyn. Liv., ii., 149, 1; Marsh., Ent. Mo. Mag., ii., 84, 1; Kirschb., Cicad., 72, 1; J. Sahl., Not. Fenn., xii., 107, 1.

♂. Face yellow; frons with a series of fine curved brown transverse lines, interrupted down the middle by a wide stripe of the pale ground colour. Crown yellow, with some irregular symmetrical black markings, which have a strong tendency to spread over the entire surface. Pronotum transversely striate, black, with a large triangle in the middle of the hind margin, and the latter narrowly, yellow; or entirely black. Scutellum yellow, more or less widely black on the sides. Elytra yellow, a large spot occupying the apex and continued in an elongate triangular form as far as the middle, and an elongate triangular stripe occupying all but the inner margin of the clavus, deep black. Abdomen above black, sides widely and hind margins of the segments narrowly yellow. Legs yellow; hind tibiæ with black points at the roots of the larger spines.

♀. Similar to the male, but a trifle larger, and having the black markings somewhat reduced. Abdomen yellow, its sides widely black. Dimorphous. Length, 5—6½ mm.

Common and generally distributed.

2. *Evacanthus acuminatus*, Fab.

Cicada acuminata, Fab., Sys. Rhyn., 76, 68.
C. interstincta, Fall., Hem. Suec., ii., 29, 6.
Tettigonia acuminata, H.-Scff., Deut. Ins. iii., 9.
Amblycephalus Germari, Curt., Brit. Ent., 572.
Evacanthus acuminatus, Burm., Handb., ii., 116, 1; Flor, Rhyn. Liv., ii., 152, 2; Marsh., Ent. Mo. Mag., ii., 85, 2; Kirschb., Cicad., 73, 2; J. Sahl., Not. Fenn., xii., 108, 2.

♂. Frons dark brown or black, with a series of fine pale transverse lines; upper margin pale, at least in the middle; cheeks pale, more or less marked with dark brown or black. Crown black, sides irregularly pale. Pronotum and scutellum black, the hind margin of the former very narrowly pale. Elytra dirty yellowish, with the inner two-thirds of the clavus, an abbreviated band across the middle of the corium, and a large spot at the apex dark brown, the thick nerves and a large triangular spot on the apex of the costa whitish. Abdomen above blackish, pale in the middle behind. Legs dirty yellow, claws black. The dark markings on the elytra have a strong tendency either to coalesce or be reduced.

♀. Face as in the last species. Crown dark brown, its sides widely pale. Pronotum dirty yellow, the sides widely and a broad central stripe black; behind each eye there is frequently a short black line or a few black points. Scutellum black, sometimes indistinctly pale at the base. Otherwise coloured as in the male, but generally paler. Dimorphous. Length, 5—6 mm.

Common.

ii. TETTIGONIA, *Geoffr.* (Pl. III., fig. 3).

Geoffr., Hist. abr. Ins., i., 429 (1762).

Upper side bare. Ocelli near the hind margin of the crown, the distance between each ocellus and the inner margin of the eye about twice as great as the distance between the ocellus and the hind margin of the crown. The frons encroaches on the horizontal upper surface of the head in the form of two wide arcuate lobes, separated from the crown proper by an impressed line, which is more distinct in the male than in the female. Submarginal wing-nerve running into the first nerve.

1. *Tettigonia viridis*, L.

Cicada viridis, Linn., Syst. Nat., v., 466, 46.
Tettigonia viridis, Germ., Mag. d'Ent., iv., 72, 25; Burm., Handb., ii., 118, 4; Flor, Rhyn. Liv., ii., 145, 1: Marsh., Ent. Mo. Mag., ii., 88, 1; Kirschb., Cicad., 72, 1; J. Sahl., Not. Fenn., xii., 105, 1.
T. arundinis, Germ., *l. c.*, 71, 24; Burm., *l. c.*, 118, 5.
Amblycephalus viridis, Curt., Brit. Ent., 572, 1.
Tettigonia flavicatella, Herkl., Faun. Nederl., i., 183, 182.

♂. Frons pale brown, the side margins, a stripe down the middle, and a series of fine curved transverse lines down each side, yellow; cheeks with a fine black line next the frons and clypeus. Crown greenish yellow, with a biarcuate line across the middle, and a pair of irregular pentagonal spots near the hind margin, black. Pronotum and scutellum yellowish green, the former sometimes irregularly marked with black in front, the latter with an abbreviated impressed transverse line near the base. Elytra subopaque, blackish blue, glaucous during life, membrane fumose. Abdomen above blue-black. Legs yellow, the claws and a fine stripe on the inner side of the hind tibiæ black, the spines of the latter springing from black points. Elytra sometimes green, with the nerves narrowly bordered with blackish.

♀. Elytra green, the costa narrowly whitish, nerves narrowly bordered with blackish. Length, 5½—9 mm.

This exceedingly handsome insect is very abundant in damp grassy places. The var. *arundinis*, Germ., has the elytra pale, with the nerves widely margined with blackish.

XIII. ACOCEPHALIDÆ.

Crown always distinctly separated from the face, generally by a well-defined ridge, its disc more or less excavated or bearing impressions, frequently transversely striate in front, at least distinctly sculptured. Ocelli on or adjoining the ridge which separates the crown from the face, or, if that is absent, on the forehead. Elytra generally coriaceous, with strongly-raised nerves; appendix wanting or very narrow.

The above definition of this family is the result of an endeavour to accomplish a convenient arrangement of the British genera included therein. In dealing with such limited material one has but little opportunity of giving due prominence to the natural affinities of the various genera, but it may be observed that *Strongylocephalus* and *Acocephalus* are very closely allied in such important points as the position of the ocelli and the structure of the wings and male genitalia. *Eupelix* combines with its own peculiar form the situation of the ocelli which obtains in the two genera last named, while the structure of its wings and male genitalia conforms to the type which is found in the genera which succeed it in the arrangement here adopted. This genus is regarded by Dr. J. Sahlberg, with considerable reason, as forming a separate group equivalent to the families

of the present work. *Platymetopius* and following genera, although sufficiently distinct from the *Jassidæ* by reason of the more elaborate structure of their head, are decidedly Jassid in their affinities, and might even be placed at the head of that family with propriety.

Table of Genera.

1 (6).	Ocelli on the crown close to its front margin.	
2 (5).	Eyes normal.	
3 (4).	Crown transversely striate in front	i. Strongylocephalus.
4 (3).	Crown not transversely striate in front	ii. Acocephalus.
5 (2).	Eyes nearly enclosed by the foliaceous edge of the crown	iii. Eupelix.
6 (1).	Ocelli on the forehead.	
7 (12).	Crown not transversely striate in front.	
8 (9).	Crown angular in front	iv. Platymetopius.
9 (8).	Crown not angular in front.	
10 (11).	Pronotum separated from prosternum by a distinct ridge	v. Graphocraerus.
11 (10).	Pronotum not separated from prosternum by a ridge	vi. Doratura.
12 (7).	Crown transversely striate in front.	
13 (14).	Crown with a linear black band adjoining and running parallel with its front margin	vii. Paramesus.
14 (13).	Crown entirely pale	viii. Glyptocephalus.

1. Strongylocephalus, *Flor*. (Pl. III., fig. 5).

Flor, Rhyn. Liv., ii., 109 (1861).

Crown obtusangularly produced and transversely striate in front; frons transversely impressed above; forehead thin and knife-like. Ocelli close to the front margin of the crown, about equidistant from the front margin and from the eyes. Elytra coriaceous, narrowly rounded at the apex, scantily pubescent along the nerves; two transverse nerves; appendix wanting. ♂: genital valve present; plates subnavicular; lower angle of pygofer with two unequal teeth, of which the front one springs from a wide base; free portion of the penis subcylindrical, bisinuate on the upper side, barbed at the apex (*agrestis*).

The two described European species are distinguished as follows:—

Length of pygofer (♂) down the middle of the upper side equal to or longer than the preceding dorsal segment. No black line on the crown in front .. 1. *agrestis*.

Length of pygofer (♂) down the middle of the upper side distinctly shorter than the preceding dorsal segment. Front of crown with a black line just beyond the ocelli .. .. 2. *Megerlei.*

1. *Strongylocephalus agrestis*, Fall.

Cicada agrestis, Fall., Hem. Suec., 36, 18.
Strongylocephalus agrestis, Flor, Rhyn. Liv., ii., 210, 6; Kirschb., Cicad., 74, 1; Scott, Ent. Mo. Mag., xi., 121, 1; J. Sahl., Not. Fenn., xii., 353, 1; Sign., Ess. Jass., 44, 1, pl. 2, fig. 18.

♂. Frons black, finely and closely spotted with yellow-brown; remainder of the face and the upper side yellow-brown, finely and more or less closely speckled with dark brown or black. Crown transversely impressed, smooth at the base, transversely striate in front. Pronotum transversely striate, front margin widely smooth. Elytra a trifle longer than the abdomen, inner margin narrowly and some irregular spots along the costa and round the hind margin dark brown or black. Abdomen above black, beneath black irregularly spotted with yellow-brown towards the apex. Legs brownish yellow, the front pairs spotted and banded with black, the hind pair striped with dark brown or black.

♀. Greyish yellow, with the dark markings very much reduced or entirely wanting; the narrow dark line on the inner margin of the elytra is the last to disappear. Hind margin of last ventral segment more or less concave, sometimes with an indication of a small notch in the middle. Length, 6—7 mm.

Marshes; not common. Chobham; near Norwich, &c.

2. *Strongylocephalus Megerlei*, Scott.

Strongylocephalus Megerlei, Scott, Ent. Mo. Mag., xi., 122, 2; Sign., Ess. Jass., 45, 2, pl. 2, fig. 19.

♂. Frons black, its lower half speckled with yellow-brown; crown brownish yellow, with a black line along the front margin; otherwise similar to *agrestis*.

♀. Frons yellow-brown, with a black line along its upper margin. Crown yellow-brown, with a black line along its front margin. This sex has a strong general resemblance to the male of *agrestis*, but it is much duller than that insect. Hind margin of the last ventral segment feebly concave, with a distinct notch in the middle. Length, 5—6 mm.

Marshes; hitherto rare. Northumberland (*Bold*); Ranworth, Surlingham, and Booton, Norfolk.

ii. Acocephalus, *Germ.* (Pl. III., fig. 6).

Germar, Silb. Rev., i., 181, 46 (1833).

Crown obtusangularly produced in front, more or less broadly excavated (in the subgenus *Anoscopus*, Kbm., slightly convex); in the male sometimes, and in the female generally, tricarinate. Ocelli on the front margin of the crown a little nearer to the eyes than to the apex. Submarginal wing-nerve incomplete. ♂: genital valve wanting; plates narrow, reflexed, connivent, subnavicular; lower angle of pygofer with a blunt semicircular tooth; penis strap-shaped, barbed at the apex and in the middle (*albifrons*). Sexes very dissimilar.

Table of Species.

1	(6).	Crown more or less broadly excavated.	
2	(5).	Excavation of crown very strong.	
3	(4).	Elytra not banded with white ..	1. *nervosus.*
4	(3).	Elytra with white bands. Crown one-third or more than one-third longer than pronotum	2. *bifasciatus.*
5	(2).	Excavation of crown very feeble. Crown not or very little longer than pronotum	3. *albifrons.*
6	(1).	Crown slightly convex, not excavated.	
7	(8).	Elytra dark brown, with broad white bands	4. *brunneo-bifasciatus.*
8	(7).	Markings of elytra longitudinal.	
9	(10).	Elytra whitish hyaline, with the nerves and a band near the apex black ..	5. *histrionicus.*
10	(9).	Nerves of elytra pale, interstices black	6. *flavostriatus.*

The foregoing table applies only to the males; the characters of the females will be found in the detailed descriptions which follow:—

1. *Acocephalus nervosus*, Schrank.

Cicada nervosa, Schr., Enum. Ins. Austr., 256, 481.

Acocephalus cardui, obscurus, sparsus, unicolor, fasciatus, pallidus, and *bicinctus*, Curt., Brit. Ent., 620, 1—8.

Acocephalus adustus, Hardy, Tr. Tyne. F. C., i., 429, 1.

A. rusticus, H.-Scff., Deuts. Ins., 124, 15; Flor, Rhyn. Liv., ii., 199, 1; Marsh., Ent. Mo. Mag., ii., 145, 1; Kirschb., Cicad., 75, 4; J. Sahl., Not. Fenn., xii., 356, 1; Sign., Ess. Jass., 16, 1, pl. 1, fig. 6.

♂. Upper side lighter or darker brown, a band across the crown, a band across the pronotum, and a narrow stripe near the

claval suture, whitish; occasionally all the nerves are pale. Frons punctato-rugulose, distinctly impressed across the top. Crown about as long as the pronotum, longitudinally striate, reflexed at the apex, its middle keel exceedingly fine. Pronotum rugulose in front, transversely striate behind. Elytra coriaceous, a little longer than the abdomen, transversely rugulose, nerves raised. Breast and abdomen black. Legs pale. Length, 5—6 mm.

♀. Upper side dirty greyish or greenish yellow, more or less closely speckled with black, and frequently having a few pale spots arranged in an irregular band-like manner across the elytra, the nerves sometimes chequered with black and pale. Crown about one-fourth longer than pronotum. Elytra as long as the abdomen, the apical areas sometimes filled up with fuscous, so as to give that part a chequered appearance. Length, 6—8 mm.

Common everywhere.

Var. *a.* Upper side reddish yellow. (♀).

Var. *b.* Upper side varying in colour from red-brown to almost black. (♀).

On the salt-marshes at Wells, Norfolk, in August, 1883, under *Obione portulacoides*, I fell in with what I can only regard as a remarkable race of this very variable species; the males are distinguished by having the upper side very pale yellow-brown with a greenish tinge, and exceedingly finely irrorated with fuscous, and the shape of the crown in extreme examples is decidedly sublunate; the range of variation in the females, however, extends to the ordinary speckled form. Both sexes appear distinctly narrower than typical *nervosus*, but I have not been able to discover any structural differences on an examination of the male genitalia.

A. carinatus, Stål (= *variegatus*, Fieb.) has been recorded as British, but a specimen lent to me by Mr. Douglas, and labelled by Dr. Signoret, is a dark example of the speckled form of *nervosus* ♀. The true *carinatus*, which is said to resemble *nervosus* ♀, should have the crown tricarinate in both sexes.

2. *Acocephalus bifasciatus*, L.

Cicada bifasciata, Linn., Faun. Suec., ed. ii., 243, 898.
Acocephalus bifasciatus, Curt., Brit. Ent., 620, 9; Flor, Rhyn. Liv., ii., 201, 2; Marsh., Ent. Mo. Mag., ii., 146, 2; Kirschb., Cicad., 76, 7; J. Sahl., Not. Fenn., xii., 357, 2; Sign., Ess. Jass., 20, 3, pl. 1, fig. 8.

A. interruptus, Fieb., Cat. nec Scott, Ent. Mo. Mag., ix., 264.
Jassus trifasciatus, Germ., Mag. d'Ent., iv., 87, 21.
Acocephalus trifasciatus, J. Sahl., Not. Fenn., xii., 358, 3; Sign., Ess. Jass., 24, 5, pl. ii., fig. 10.
A. dispar and *nigritus*, Kirschb., Cicad., 76, 5 and 6.
A. tricinctus, Curt., Brit. Ent., 620; Sign., Ess. Jass., 22, 4, pl. ii., fig. 9.

♂. Upper side dark red-brown, varying to blackish brown; a band across the pronotum and two wide bands across the elytra white. Crown tricarinate, at least one-third longer than pronotum, strongly reflexed at the apex, the sculpture of its disc spreading obliquely on each side of the middle keel; that beyond the side keels also oblique. Pronotum uneven, with a scattered shallow punctuation in front, even and finely transversely striate behind. Elytra very finely reticulato-punctate, with a scattered shallow punctuation, about as long as the abdomen, rather narrowly rounded at the apex; one or both of the white bands are not unfrequently interrupted, and the apex is often more or less broadly white. Frons yellowish white, punctured like the elytra, with a large impression in each upper angle. Breast yellowish white, metasternum with a blackish spot on each side. Abdomen black. Legs pale, front pairs blackish at the apex; hind tibiæ and tarsi black. Length, 3½—4 mm.

♀. Upper side pale brownish grey speckled with brown; elytra with two more or less interrupted pale bands, the nerves brown. Crown tricarinate, nearly twice as long as the pronotum. The whole upper side very finely reticulato-punctate, with a scattered shallow punctuation. Length, 4¼—5 mm.

Not common; more frequent in the north.

3. *Acocephalus albifrons*, L.

Cicada albifrons, Linn., Faun. Suec., 241, 884.
C. nitidula, Don., Brit. Ins., viii., 87, pl. 288, fig. 1.
Aphrodes testudo, Curt., Ent. Mag., i., 195.
A. concinna, Curt., Brit. Ent., 633, 1.
Acocephalus arcuatus and *confusus*, Kirschb., Cicad., 75, 3, and 78, 11.
A. albifrons, Flor, Rhyn. Liv., ii., 208, 3; Marsh., Ent. Mo. Mag., ii., 177, 3; J. Sahl., Not. Fenn., xii., 360, 5; Sign., Ess. Jass., 30, 9, pl. ii., fig. 14.

A. nigropunctatus, J. Sahl., *l. c.*, 360, 4.
A. interruptus and *polystolus*, Scott, Ent. Mo. Mag., ix., 264 and 265.

♂. Upper side reddish yellow, becoming darker (in some examples almost black) towards the apex of the elytra, the latter with two wide more or less interrupted bands, and the apex broadly white. Face not impressed above. Crown feebly impressed just behind the apex, about equal in length to the pronotum, its middle keel very fine. Elytra a trifle longer than the abdomen; that portion of the dark ground colour which precedes the white space at the apex frequently assumes the appearance of a black or blackish band. Under side and legs pale; hind tibiæ generally blackish. Length, 3—3½ mm.

♀. Upper side pale grey, more or less closely speckled with fuscous or black. Face very feebly impressed above. Crown tricarinate, about as long as the pronotum, more distinctly impressed than in the male. Elytra as long as the abdomen, their apex generally having a chequered appearance, owing to the apical areas being filled up with fuscous; not unfrequently two bands are indicated by a few pale spots, and generally the axillary and anal nerves are white at the apex; sometimes all the nerves of the corium are chequered with black and pale. Face pale, breast and abdomen blackish. Length, 3½—4½ mm.

Common amongst low plants. The above description applies to the ordinary form of this species as it occurs in inland situations, but in salt-marshes, under *Obione portulacoides*, &c., the following marked varieties occur :—

a. Upper side dark brown, the white spots forming the bands on the elytra very much reduced. (♂).

b. Upper side entirely very dark red-brown. (♂).

c. Upper side brownish grey, the white space at the apex of the elytra bounded inwardly by a black band.

Although, in deference to common usage, I put the three last-mentioned forms as varieties of *albifrons*, it is by no means certain that the salt-marsh insect does not constitute a good species; both sexes are at least one-third larger than the ordinary form, the angle of the crown in the male is more acute, and its apex is more distinctly reflexed; the upper side of the female is pale, uniformly and more or less closely irrorated with fuscous or black, the apices of the claval nerves are never white, nor are the elytra chequered with black and pale round the apex, as is generally the case in the ordinary form.

The difference in habitat, the larger size of both sexes, and the uniform coloration of the female, all which matters are very constant, seem to me to indicate a distinct species, although I have not detected any appreciable structural differences in the male genitalia of the two forms. According to a specimen labelled by Dr. Signoret my *c* is the *polystolus* of Fieber; the *polystolus* of Scott seems to be my *a*.

4. *Acocephalus brunneo-bifasciatus*, Geoffr.

Cicada brunneo-bifasciata, Geoffr., Hist. Abr. Ins., 425, 22.
C. serratulæ, Fab., Ent. Sys., iv., 41, 63.
Jassus serratulæ, H.-Scff., Deuts. Ins., 130, 5.
Acocephalus serratulæ, Kirschb., Cicad., 78, 12; J. Sahl., Not. Fenn., xii., 362, 6.
A. brunneo-bifasciatus, Sign., Ess. Jass., 36, 10, pl. ii., fig. 15.

♂. Very similar in appearance to the ordinary form of the preceding species, but the crown, which is about as long as the pronotum, and has a fine middle keel, is feebly convex instead of impressed. The following differences in coloration. which are sufficiently constant, facilitate its separation from *albifrons*: the hind margin of the pronotum is broadly white, the space between the first and second white bands on the elytra is equal in depth of colour to the space between the second white band and the white space at the apex, which is seldom or never the case in the ordinary form of *albifrons*, and the apices of the tibiæ and the tarsi of the front pairs of legs are much more conspicuously black. Length, 4 mm.

♀. I do not know this sex, but, judging from descriptions, it is greyish yellow, more or less closely speckled with fuscous, with some whitish spots on the suture, and the apical areas filled up with fuscous.

Amongst herbage at the roots of trees, &c.; not common.

5. *Acocephalus histrionicus*, Fab.

Cercopis histrionicus, Fab., Ent. Syst., iv., 56, 44; Sys. Rhyn., 98, 62.
Acocephalus histrionicus, Flor, Rhyn. Liv., ii., 208, 5; Marsh., Ent. Mo. Mag., ii., 179, 5; Kirschb., Cicad., 77, 9; J. Sahl., Not. Fenn., xii., 364, 8; Sign., Ess. Jass., 38, 11, pl. ii., fig. 16.
A. arenicola, Marsh., *l. c.*, 180, 6, sec. spec. comm.

♂. Face yellowish white; forehead black, with a roundish white spot in the middle, and sometimes another on each side; crown yellowish white, with a band across the apex, a roundish spot on each side of the base, and a line down the middle, black. Pronotum white, the hind margin narrowly, and a band on the front half, black. Scutellum blackish. Elytra whitish hyaline, the nerves narrowly, and a band before the apex, black. Crown a trifle shorter than the pronotum, finely but distinctly reticulato-punctate, its middle keel very fine. Abdomen black. Legs pale; tarsi of the front pairs and tibiæ and tarsi of the hind pair blackish. Length, 4 mm.

♀. Upper side dirty greyish white, more or less variegated with fuscous. Crown and pronotum with a coarse rough punctuation, which passes into transverse striation on the hinder half of the latter, the former tricarinate. Elytra longer than the abdomen; costa and inner margin blackish, widely interrupted with white; a fuscous spot on the hind margin in each of the apical areas; nerves brownish, more or less interrupted with white. Length, 4½ mm.

On coast-sands, &c.; not very common.

6. *Acocephalus flavostriatus*, Don.

Cicada flavostriata, Don., Brit. Ins., viii., 28, pl. 288, fig. 2.

Jassus rivularis, Germ., Mag. d'Ent., iv., 89, 26.

Aphrodes rivularis, Curt., Brit. Ent., 633, 8.

Acocephalus rivularis, Flor, Rhyn. Liv., ii., 205, 4; Marsh., Ent. Mo. Mag., ii., 178, 4; Kirschb., Cicad., 77, 10; J. Sahl., Not. Fenn., xii., 364, 7; Sign., Ess. Jass., 39, 12, pl. ii., fig. 17.

♂. Yellowish white; a black patch on the disc of the face and one on each side above, a band across the apex, a toothed band on the hind margin and sometimes a line down the middle of the crown, a band across the pronotum, a spot on the disc and the angles of the scutellum, and the spaces between the nerves of the elytra, black. Breast and abdomen beneath pale, a spot on each side of the former and a stripe on each side of the latter black. Legs pale; the apices of the tibiæ and tarsi of the front pairs, the apices of the hind thighs, and the hind tibiæ and tarsi wholly, black. Crown a little longer than the pronotum, finely reticulato-punctate, its middle keel very fine and indistinct. Length, 3 mm.

♀. Upper side dirty greyish yellow, the fore parts more or less closely mottled with fuscous or black, the spaces between the

nerves of the elytra fuscous. Crown about one-third longer than pronotum, tricarinate, the side keels obtuse and indistinct. Length, 3½—4 mm.

Very common amongst low plants, especially in damp places.

iii. EUPELIX, *Germ.* (Pl. III., fig. 4).

Germar, Mag d'Ent., iv., 94 (1821).

Head subtriangular, as long or longer than the pronotum and scutellum together, very thin and flat, more or less strongly reflexed at the apex. Crown with a strong middle keel and an oblong callus on each side at the base. Frons with a sharp middle keel. Pronotum with three keels, one in the middle and one behind each eye, its sides of considerable length, and separated from the prosternum by a distinct ridge. Elytra subcoriaceous, rounded and not overlapping at the apex; appendix very narrow; nerves strongly raised; one transverse nerve. Wings of the Jassid type.

1. *Eupelix cuspidata*, Fab.

Cicada cuspidata, Fab., Ent. Syst., iv., 46, 86.
C. depressa, Fab., Sys. Rhyn., 66, 19.
Eupelix cuspidata, Germ., Mag. d'Ent., iv., 94, 1; Fall., Hem. Suec., ii., 22, 1; Flor, Rhyn. Liv., ii., 215, 2; Marsh., Ent. Mo. Mag., ii., 199, 2; Kirschb., Cicad., 79, 1: J. Sahl., Not. Fenn. xii., 367, 1; Sign., Ess. Jass., 11, 3, pl. i., fig. 3; Scott, Ent. Mo. Mag., xv., 232, 1.
E. producta, Germ., Faun. Ins. Eur., xx., 24; Burm., Gen. Ins., ii., figs. 1 and 5; Flor, Rhyn. Liv., ii., 215, 1; Marsh., Ent. Mo. Mag., ii., 198, 1; Kirschb., Cicad., 80, 3; J. Sahl., Not. Fenn., xii., 368, 2; Sign., Ess. Jass., 10, 2, pl. i., fig. 2; Scott, Ent. Mo. Mag., xv., 233, 2.
E. spathulata, Germ., Faun. Ins. Eur., xx., 25; Burm., Gen. Ins., i., fig. 6; Kirschb., Cicad., 80, 4: J. Sahl., Not. Fenn., xii., 369, 3; Scott, Ent. Mo. Mag., xv., 233, 3.
E. depressa, Sign., Ess. Jass., 8, 1, pl. i., fig. 1.

Yellowish grey; head with dark brown or black markings; elytra sparingly irrorate with dark brown or black, the spots being chiefly confined to the nerves; abdomen with five black stripes, three above and two below.

♂. Crown with a wide central stripe, a transverse marking before the apex, and one or more curved bands proceeding from the middle keel to the side margin, and widening outwardly, dark brown or black. Of these markings the transverse one before the apex is the most constant.

♀. Paler, the irroration on the elytra almost or entirely wanting, and the markings on the crown reduced to a central stripe, and a few spots on the margin round the apex. Length, 5½—7¼ mm.

At the roots of low plants; not very common.

This species is usually divided into three, namely:—

1, *cuspidata*, Fab., having the crown broader than long, its sides strongly rounded, and the apex somewhat cuspidate (in the female with the sides nearly straight).

2, *depressa*, Fab., having the crown longer than broad, with its sides strongly sinuate.

3, *producta*, Germ., a form intermediate between the two preceding, having the crown somewhat equilaterally triangular, its sides straight or very faintly concave near the ocelli.

All these forms may sometimes be taken in company. The characters laid down by authors derived from the genitalia are simply differences of degree.

iv. PLATYMETOPIUS, *Burm.* (Pl. III., fig. 7).

Burmeister, Gen. Ins., ii. (1839).

Crown angularly produced, impressed across the base, its apex somewhat reflexed. Forehead forming a strong ridge in the male. Upper margin of the frons narrowly impressed. Sides of pronotum distinctly separated from prosternum. Elytra ample, with two or three extra transverse nerves in the costal area towards the apex; appendix narrow. Wings of the Jassid type.

1. *Platymetopius undatus*, DeGeer.

Cicada undata, DeGeer, Abh. Gesch. Ins., iii., 119, 5, t. 1, fig. 24; Fall., Hem. Suec., ii., 29, 7.

Platymetopius undatus, Flor, Rhyn. Liv., ii., 221, 1; Kirschb., Cicad., 147, 27; Fieb., Syn. Eur. Delt., 202, 4, t. 6, fig. 64 (excluding *f*); J. Sahl., Not. Fenn., xii., 296, 1; Scott, Ent. Mo. Mag., xix., 155.

P. undulatus, Thoms., Opusc. Ent., i., 46, 1.

♂. Deep yellow; the disc of the crown, the pronotum, and an angularly-bisinuate stripe narrowly white on its outer edge and occupying the inner half of each elytron, chocolate-brown, finely speckled with yellow; along the suture, and in the base of the apical and the apex of the subapical areas, a few (about nine) small round white spots; abdomen above widely black down the middle. Crown as long as the pronotum, distinctly longer than its width between the eyes. Elytra parallel-sided, their apex truncate, with rounded angles. Genital valve subequilaterally triangular, plates about twice as long as the valve, subnavicular, rather abruptly reflexed about the middle, acuminate at the apex.

♀. Similar in colour to the male, but the crown is distinctly shorter than its width between the eyes. Last ventral segment about one-half longer than the preceding, the subquadrate middle lobe of its hind margin bounded on each side by a deep angular notch, and having its hind angles produced into a spine, and a small notch in the middle of its hind margin. Fieber's figure (Syn. Eur. Delt., t. 6, fig. 64, *f*) does not represent the last ventral segment of this species. Length, 5—6 mm.

On *Pteris*; Cann Quarry, Bickleigh Vale (*Scott*, 1882).

v. Graphocræerus, *Thoms.* (Pl. III., fig. 2).

Thomson, Opusc. Ent., i., 57 (1869).

Crown subangularly produced, impressed on each side at the base, reflexed at the apex. Frons convex, slightly impressed above. Pronotum separated from prosternum by a ridge. Elytra subopaque, with one transverse nerve. Wings of the Jassid type. ♂: Genital valve present; plates wide, convex, subvertical, diverging behind; lower angle of pygofer strongly acuminate.

1. *Graphocrærus ventralis*, Fall.

Cicada ventralis, Fall., Act. Holm., 18, 9 (1805); Hem. Suec., ii., 31, 9.
Athysanus ventralis, Flor, Rhyn. Liv., ii., 277, 3: Kirschb., Athys. Art., 13, 17; Cicad., 122, 76.
Graphocrærus ventralis, Thoms., Opusc. Ent., i., 57, 25; J. Sahl., Not. Fenn., xii., 289, 1; Scott, Ent. Mo. Mag., xii., 25.

Greenish yellow; a point above the base of each antenna, a pair of points on the apex of the frons, a row of four equidistant points across the crown, and four points on the pronotum, one behind each eye and a pair in the middle near the front margin, black;

abdomen black at the base in the male; tibiæ with black points. Crown somewhat longer than half the width of its hind margin, a trifle shorter than the pronotum, nearly twice as long in the middle as at the sides. Elytra somewhat longer than the abdomen (♂) or shorter than the same (♀); the apical areas short. In the female the two lateral, or all the black points on the pronotum, are sometimes wanting, and the elytra are occasionally clouded with grey in the middle. Length, 5½—6 mm.

Not common; Weybridge and Lee, July; Abbey Wood, August.

vi. Doratura, *J. Sahl.* (Pl. III., fig. 8).

J. Sahl., Not. Fenn., xii., 291, 30 (1871).

Crown subangularly produced, widely impressed across the base, reflexed at the apex. Frons flat, transversely impressed above. Sides of pronotum not margined. Insect generally brachypterous, in which case the elytra are less than one-half as long as the abdomen and truncate behind. First and second wing-nerves confluent and forming one nerve shortly before the apex of the wing. Apex of the abdomen in the female strongly acuminate.

1. *Doratura stylata*, Boh.

Athysanus stylatus, Boh., Sv. Ak. Handl., 1847, 37, 5; Kirschb., Athys. Art., 14, 18; Cicad., 123, 77; Flor, Rhyn. Liv., ii., 273, 1.
Jassus stylatus, Thoms., Opusc. Ent., i., 58, 27.
Doratura stylata, J. Sahl., Not. Fenn., xii., 292, 1; Scott, Ent. Mo. Mag., xi., 148, 1.

♂. Pale grey or yellowish grey; three spots on the forehead, of which the middle one is the largest and oblong, two bands across the face, and sometimes some markings on the loræ and clypeus, black. Crown obtusely produced, one-half longer in the middle than at the sides, and one-third longer than the pronotum, which is at least three times as wide as long. Elytra coriaceous, rugulose, rather more than one-third as long as the abdomen, their apex truncate, with rounded angles. Abdomen above with one or two fine black longitudinal lines on each side broken up into points or short lines, and frequently a transverse row of black points across each segment; on the under side each segment is occupied by a large crescent-shaped black spot. Legs pale; front pairs of thighs sometimes with a black band near the apex; hind tibiæ with a black stripe on the inner side and a row of black

points on the outer side. Pygofer with three black spots above; genital valve extremely short; plates about as long as the last ventral segment, obtusely rounded at the apex.

♀. A small suboval spot in the middle of the last dorsal segment, the hind margin of the latter and a fine line down the middle of the pygofer above black; otherwise coloured like the male. Last ventral segment one-half longer than the preceding, subtruncate behind; saw-case about three times as long, its apical third free.

Macropterous form.—Elytra dirty whitish, subopaque, scarcely reaching to the apex of the last dorsal segment; appendix of nearly equal width throughout, reaching as far as the first apical area. Length, 2¾—4 mm.

Common on the ground on heaths, coast-sands, &c.; the macropterous form very rare. On the sand-hills at Hunstanton, in July, 1885, I took several examples of a large pale race of this species. In actual measurement these are about one-half larger than the ordinary form (♂ 4 mm., ♀ 5½ mm.), but the difference in size is apparently much greater; the ordinary form occurred in a salt-marsh just behind the sand-hills, but the two races were not intermingled. I have not detected any structural differences between the two. *Doratura homophylla*, Flor, a species not unlikely to occur here, is distinguished by the genital valve in the male, which is nearly as long as the last ventral segment, and the last ventral segment in the female, which is twice as long as the preceding segment, and roundly produced behind.

vii. Paramesus, *Fieb.* (Pl. III., fig. 9).

Fieber, Neue Gatt. und Art. Homop., 10, 27 (1866).

Crown sublunate or slightly produced, with a wide transverse impression on the disc. Forehead and front of the crown transversely striate. Frons flattish, dull, exceedingly finely and closely punctured. Sides of pronotum very short, not margined. Elytra about as long or a little longer than the abdomen, normally with two transverse nerves; appendix very narrow or entirely wanting. Wings of the Jassid type.

Our two species may be distinguished as follows:—

Frons between the antennæ nearly three times as wide as the base of the clypeus. Insect broad .. .. 1. *nervosus.*

Frons between the antennæ not more than twice as wide as the base of the clypeus. Insect narrow .. 2. *phragmitis.*

1. *Paramesus nervosus*, Fall.

Cicada nervosa, Fall., Hem. Suec., ii., 39, 23.
Athysanus obtusifrons, Stal, Ofv., 174, 4.
Paramesus obtusifrons, Fieb., Neue Gatt. und Art. Hom., 10, 19, pl. vii., fig. 20.
Jassus nervosus, Thoms., Opusc. Ent., i., 65, 43.
Paramesus nervosus, J. Sahl., Not. Fenn., xii., 286, 1.
Athysanus Verralli, Scott, Ent. Mo. Mag., xi., 268.
A. nervosus, Scott, *l. c.*, xii., 168, 15.

♂. Oblong, brownish yellow; forehead with a pale yellow transverse line, bounded above and below by an arcuate black one; frons black or brown, with a few pale curved transverse lines and some indication of a pale middle stripe below; outline of the loræ and clypeus and a line down the middle of the latter black; front margin of pronotum narrowly black. Scutellum sometimes with a dark triangle in each basal angle. Nerves of the elytra pale, the areas of the corium evenly margined with black, the apical areas dark fuscous. Crown a little longer in the middle than at the sides, and about equal in length to one-half of its basal width. Pronotum about two and a half times as wide as long, one-third longer than the crown, and subequal in length to the scutellum. Abdomen black. Legs pale, striped, spotted, and banded with black.

♀. Similar in coloration to the male, but larger and much paler; the dark margins to the areas fuscous or entirely wanting. Abdomen pale, striped with fuscous. Length, 6—6½ mm.

On rushes in muddy salt-marshes; local, but abundant where it occurs.

2. *Paramesus phragmitis*, Boh.

Thamnotettix phragmitis, Boh., Sv. Ak. Handl., 1847, 34, 7; Kirschb., Cicad., 100, 35.
Jassus phragmitis, Thoms., Opusc. Ent., i., 65, 50.
Deltocephalus phragmitis, Fieb., Syn. Eur. Delto., 3, 2, fig. 2.
Paramesus phragmitis, J. Sahl., Not. Fenn., xii,, 287, 2.

Elongate. Crown slightly roundly produced, somewhat shorter than the pronotum, whitish, with two rust-yellow patches on the disc; forehead with a whitish band, bounded above and below by a black line. Frons narrow with nearly straight sides, pale brown, sometimes with a few pale curved lines on each side. Pronotum

whitish, with six rust-yellow spots, two in front and four in a transverse row behind. Scutellum whitish, with three sometimes confluent rust-yellow spots. Elytra greyish yellow, distinctly longer than the abdomen; nerves thickened, whitish, narrowly margined with fuscous; two points near the apex and some streaks on the costa behind the middle black. Abdomen above black, sides pale, beneath pale with black side stripes. Legs pale yellow, with black points. Length, 4—5 mm.

I introduce this addition to our fauna on the strength of a single specimen which I found amongst some Cicadina sent to me for names by Mr. Buckton; he is positive that the example in question is British, and is nearly certain that it was taken at Haslemere. It occurs in South Finland on reeds from July to September.

viii. GLYPTOCEPHALUS, *Edw.* (Pl. III., fig. 10).

Edwards, Ent. Mo. Mag., xx., 148 (1883).

Crown subangularly produced, with a narrow impression running parallel with its front margin. The temples and front margin of the crown transversely striate. Frons rather flat, dull, exceedingly finely and closely punctured with some transverse curved rows of large shallow punctures above. Angle of the cheeks almost a right angle. Sides of pronotum exceedingly short, not margined. Elytra a trifle shorter than the abdomen, their apices rounded and overlapping; appendix extremely narrow; one transverse nerve. Wings of the Jassid type.

1. *Glyptocephalus proceps*, Kbm.

Athysanus proceps, Kirschb., Cicad., 105, 44.
A. canescens, Doug. and Scott, Ent. Mo. Mag., ix., 210; Scott, Ent. Mo. Mag., xii., 95, 1.
Glyptocephalus canescens, Edw., Ent. Mo. Mag., xx., 148.

Very pale yellow; elytra white, with a peculiar hoary appearance, which is very conspicuous during life; the areas, except the brachial, generally occupied by a black or fuscous stripe; a stripe along the lower margin of each eye as far as the antenna, a wide curved band across the upper part of the frons, the apex of the rostrum, the facial sutures very narrowly, three acuminate stripes on the upper side of the abdomen, and sometimes two or three on its under side, an angular patch on the mesosternum, a spot on each front coxa, and sundry lines, bands, and points on the legs,

black. Crown pointed, twice as long in the middle as at the sides, about as long as half its basal width. Pronotum as long as the crown or a little longer, its hinder half transversely striate. Length, 4—5 mm.

Amongst grass; widely distributed, but not common.

XIV. JASSIDÆ.

Oblong or elongate species of small or medium size. Ocelli on the forehead, which is more or less obtuse and never keeled Upper branch of the cubital nerve sometimes obsolete or wanting, the lower branch joined to the brachial nerve by one or two transverse nerves. Submarginal wing-nerve complete; first and third wing-nerves simple, the second forked, its upper and lower branches either connected with the first and third respectively by a transverse nerve or shortly confluent with those nerves, except in *Gnathodus*, where the upper branch is confluent with the first wing-nerve as far as the submarginal nerve. Front pairs of tibiæ subterete, spinose on the outer side; hind tibiæ quadrangular-prismatic, with four rows of spines.

A somewhat numerous group, distinguished from all our other species with multispinose hind tibiæ by the position of the ocelli, the absence of any well-defined border separating the crown from the face, and the branched nerves of the corium.

The black markings which occur on the heads of many members of the genus *Athysanus*, and some others of this family, notwithstanding a great tendency either to exaggeration or reduction, frequently form valuable aids to identification, and the following names for the various parts of what may be considered as the normal pattern are proposed with a view to render intelligible any reference to the subject in the descriptions which follow. Proceeding forwards from the hind margin of the crown we have:—

1st. Two *basal markings*, one on each side, generally either punctiform or annular

2nd. An *interocular line*, running straight across the crown at the level of the apex of the inner margin of the eye.

3rd. The *interocellar line*, connecting the ocelli and sometimes extending as far as the eyes, widened, angularly bent forward, and generally interrupted in the middle.

4th. The *infraocellar line*, which runs across the forehead and adjoins the ocelli on their lower side. This line, which is frequently biarcuate and sometimes interrupted in the middle, is not to be confounded with the uppermost of the ordinary series of transverse lines on the frons, from which it is quite distinct in character.

These details are present in various combinations in different species, but the whole may generally be observed in a well-marked example of *Athysanus sordidus*, Zett. In several species of *Athysanus*, &c., there exists a dark form, generally of the male sex, in which all the dark markings proper to the species are very strongly developed, and which has consequently a very different appearance to the prevalent form. *Athysanus piceus*, Scott, is a case in point. This insect is the dark form of *Athysanus obsoletus*, Kbm., as pointed out to me by Dr. J. Sahlberg, and since confirmed by the examination of a series of intermediate examples and the dissection and comparison of the male genitalia. In working from descriptions of the female only it should be borne in mind that the crown in that sex is usually longer and more pointed than in the male, and the general coloration is paler.

TABLE OF GENERA.

1 (6).	Elytra not overlapping at the apex.	
2 (5).	Crown not sharply angular in front, seldom longer than the pronotum. Species for the most part large and stout.	
3 (4).	Elytra hyaline	i. STICTOCORIS.
4 (3).	Elytra subcoriaceous	ii. ATHYSANUS.
5 (2).	Crown sharply angular in front, frequently much longer than the pronotum. Species small and narrow	iii. DELTOCEPHALUS.
6 (1).	Elytra distinctly overlapping at the apex.	
7 (12).	Inner margin of the clavus much longer than the membrane.	
8 (11).	Sides of pronotum of moderate length, separated from prosternum by a distinct keel.	
9 (10).	Crown widely rounded in front. Elytra with many supernumerary white transverse nerves	iv. ALLYGUS.
10 (9).	Crown angularly produced in front. Supernumerary white transverse nerves, if present, very few	v. THAMNOTETTIX.

11 (8). Sides of pronotum extremely short; keel obsolete or wanting .. .. .. vi. LIMOTETTIX.
12 (7). Membrane as long as the inner margin of the clavus .. .. vii. GNATHODUS.

i. STICTOCORIS, *Thoms.* (Pl. III., fig. 11).

Thomson, Opusc. Ent., i. (1870).

Body robust, ovate. Head with the eyes wider than the pronotum, obtuse in front. Crown convex, sublunate, very feebly roundly produced in the middle. Frons longer than its width across the base; cheeks wide, base of the loræ subequal in width to the base of the clypeus. Rostrum stout, longer than the clypeus. Sides of the pronotum very short, obtusely and indistinctly margined. Elytra hyaline, ample, about as long as the abdomen, not overlapping at the apex; appendix very narrow; four short apical and five subapical areas.

1. *Stictocoris Preyssleri*, H.-Scff.

Jassus Preyssleri, H.-Scff., Deuts. Ins., 164, 7; Flor, Rhyn. Liv., ii., 288, 8; Kirschb., Cicad., 121, 75; Thoms., Opusc. Ent., i., 61, 13.
Thamnotettix adumbrata, Boh., Sv. Ak. Handl., 41, 16 (1847).
Stictocoris Preyssleri, J. Sahl., Not. Fenn., xii., 258, 3.
Thamnotettix Preyssleri, Scott, Ent. Mo. Mag., xii., 25, 11; Fieb., Cicad. d'Eur. (*Thamnotettix*), 99.

Pale yellowish white; four spots on the crown, one at the base, and three at the front margin, the latter continued on to the frons, a spot at the base of each antenna sometimes, and a wide middle stripe on the pronotum and scutellum, black; elytra hyaline, with the inner margin narrowly and a stripe running along the inner branch of the cubital nerve, and fading behind, fuscous or black. Crown obtusely pointed, one-half longer in the middle than at the sides, and about half as long as its basal width. Abdomen above black, narrowly yellow at the sides; beneath yellow, with a black middle stripe. Legs yellow, with or without black lines and points. Length, 3—3½ mm.

Said to occur in July and August on *Genista*.

ii. Athysanus, *Burm.* (Pl. III., fig. 12).
Burmeister, Gen. Ins., ii. (1838).

Body robust, somewhat rounded at the sides. Head with the eyes somewhat wider than the pronotum, obtuse in front; crown obtusely produced, convex above, ocelli near the eyes; frons wide, somewhat convex; clypeus wide, its base distinctly wider than the base of the lora; cheeks wide, reaching to the apex of the clypeus. Pronotum short, transverse, its sides not or only faintly margined. Elytra subcoriaceous, not overlapping at the apex, sides slightly rounded; five subapical areas; appendix wanting or extremely narrow; generally somewhat or even much shorter than the abdomen, with very short apical areas, but occasionally longer than the abdomen, with the apical areas fully developed, in which case the elytra overlap somewhat at the apex, owing to the development of the appendix; wings frequently much abbreviated.

Table of Species.

1 (2).	Upper side rust-red, with or without dark dark markings	1. *russeolus.*
2 (1).	Upper side not as above.	
3 (10).	Dark markings of the crown a transverse line or lines, or entirely wanting.	
4 (9).	Interocular line level with the apex of the inner margin of the eye.	
5 (8).	Front of crown angular.	
6 (7).	Species smaller, angle of crown more pointed, pronotum at least three times as broad as long..	2. *brevipennis.*
7 (6).	Species larger, angle of crown less pointed, pronotum about twice as broad as long ..	3. *sordidus.*
8 (5).	Front of crown roundly produced	4. *Sahlbergi.*
9 (4).	Interocular line placed considerably behind the apex of the inner margin of the eye	5. *grisescens.*
10 (3).	Crown with several black spots, but no transverse line.	
11 (16).	Elytra more or less closely speckled with black.	
12 (13).	Transverse nerve and the apices of the anal and axillary nerves milk-white	6. *communis.*
13 (12).	No milk-white spots on the elytra.	
14 (15).	Length, 3—3½ mm. Outer margin of genital plates straight	7. *obscurellus.*
15 (14).	Length, 4½—5½ mm. Outer margin of genital plates gently convex ..	*obsoletus* (var. *piceus*).
16 (11).	Elytra not or scarcely speckled with black.	
17 (18).	Frons suddenly narrowed at the level of the antennæ. Species large and wide ..	8. *obsoletus.*
18 (17).	Frons regularly narrowed throughout. Species small and narrow	9. *melanopsis.*

1. *Athysanus russeolus*, Fall.

Cicada russeola, Fall., Hem. Suec., ii., 34, 14.
Jassus russeolus, Thoms., Opusc. Ent., i., 56, 24.
Athysanus russeolus, J. Sahl., Not. Fenn., xii., 274, 10.

Fore parts rust-red; elytra pale brown, generally with all the areas narrowly margined with fuscous. Crown obtusely produced, one-half longer in the middle than at the sides, and about half as long as its basal width; interocular line straight, narrowly interrupted in the middle; interocellar line interrupted in the middle, the inner end of each half suddenly bent forward; infraocellar line biarcuate, interrupted in the middle. Frons with a double middle stripe, a few transverse curved lines down each side, and the facial sutures, black. Pronotum about one-third longer than the crown, sparingly speckled with black. Elytra subcoriaceous, about as long as the abdomen, narrowed behind; nerves concolorous; appendix very narrow. Abdomen rust-red, darker down the middle of the back. Legs striped and spotted with fuscous. Length, 3½ mm.

Pitlochry, Perthshire (*Norman*); Addington Hills (*Douglas*). The dark markings of the upper side are sometimes wanting, but the species may always be easily identified by the rust-red ground colour of its fore parts. It is said to occur on heath in July and August.

2. *Athysanus brevipennis*, Kbm.

Athysanus brevipennis, Kirschb., Athys. Art., 9, 9; Cicad., 113, 61; Flor, Rhyn. Liv., ii., 305, 15; J. Sahl., Not. Fenn., xii., 270, 7.
A. depressus, Scott, Ent. Mo. Mag., xii., 95, 2.
Jassus porrectus, Thoms., Opusc. Ent., i., 56, 22.

Upper side shining lighter or darker brownish yellow; frons with the usual curved transverse lines. Crown as long or slightly longer than the pronotum, at least twice as long in the middle as at the sides, subequal in length to half its basal width; interocular line abbreviated at each end, scarcely interrupted in the middle; infraocellar line biarcuate, generally very faint; interocellar line wanting. Elytra about one-third shorter than the abdomen, obliquely subtruncate at the apex, the apical areas extremely short; nerves pale, frequently narrowly bordered with fuscous. Abdomen pale, blackish towards the base; each of the apical dorsal segments frequently bearing a transverse row of dark points. Legs concolorous, with the usual dark markings. Length, 3½—4 mm.

Braemar; Pitlochry; Huddersfield. A small rather flat species, easily recognised by its Deltocephaloid crown and pronotum.

3. *Athysanus sordidus*, Zett.

Cicada sordida, Zett., Faun. Ins. Lapp., i., 531, 26.
Thamnotettix sordidus, Zett., Ins. Lapp., 295, 14.
Jassus sordidus, H.-Scff., Deuts. Ins, 130, 12; Flor, Rhyn. Liv., ii., 296, 12; Thoms., Opusc. Ent., i., 55, 21.
Athysanus confusus, Kirschb., Cicad., 107, 46.
A. sordidus, J. Sahl., Not. Fenn., xii., 265, 4; Scott, Ent. Mo Mag., xii., 96, 4; Reut., Medd. Faun. Flor Fenn., v. (1880), 224.

Oblong, slightly rounded at the sides; female much narrowed behind; elytra slightly (♂) or one-third or more (♀) shorter than the abdomen; nerves whitish. Crown a little longer than half its basal width, twice as long in the middle as at the sides, a trifle shorter than the pronotum, its free sides nearly straight, the angle pointed; interocular line generally widely interrupted in the middle,; interocellar line feeble; infraocellar line biarcuate. A very variable species in point of colour. The normal form is pale yellowish grey, with the lines on the head and some markings on the pronotum and scutellum black, and the areas of the elytra more or less filled up with fuscous. The dark form of the male has the elytra black with pale nerves, but a very pale immaculate form of both sexes is perhaps the most frequent. Of the dark markings on the elytra, a spot next the transverse nerve is the last to disappear. Hind margin of the last ventral segment in the female subangularly concave, with a strong black triangular tooth in the middle. Length, 3½—4½ mm.

Common and generally distributed. The macropterous form, which is rare, has the elytra a little longer than the abdomen, and slightly overlapping at the apex.

4. *Athysanus Sahlbergi*, Reut.

Athysanus Sahlbergi, Reut., Medd. Faun. Flor Fenn., v. (1880), 209 and 219.
A. æmulans, J. Sahl., Not. Fenn., xii., 264, 3 (♂).
A. confusus, J. Sahl., *l. c.*, 267, 5 (♀).

Similar to the preceding, but larger and stouter, with both the crown and forehead much more obtuse. Crown one-fourth longer

in the middle than at the sides, in the female as long, in the male a little longer than half its basal width, its free sides curved, and the angle rounded off. All the markings on the head, except the infraocellar line, more or less distinct. A few black or fuscous points on the front half of the pronotum, a double fuscous stripe on the scutellum, sometimes continued on the hinder half of the pronotum, and the areas of the elytra, more or less filled up with fuscous. Length, 4½—5½ mm.

Pitlochry (*Norman*); Norfolk. Not common; sometimes it occurs in company with *A. sordidus*, but it appears to be restricted to very marshy places; in the field it might be easily passed over as *A. obsoletus*, although I have seldom met with it in company with that species.

5. *Athysanus grisescens*, Zett.

Cicada grisescens, Zett., Faun. Ins. Lapp., i., 570, 25.
Thamnotettix grisescens, Zett., Ins. Lapp., 295, 15.
Jassus grisescens, Flor, Rhyn. Liv., ii., 300, 13; Kirschb., Cicad., 106, 45; Thoms., Opusc. Ent., i., 54, 19.
Athysanus cognatus, Doug. and Scott, Ent. Mo. Mag., ix., 211.
A. validinervis, Kirschb., Cicad., 113, 60 (♀).
A. grisescens, Scott, Ent. Mo. Mag., xii., 95, 3; J. Sahl., Not. Fenn., xii., 268, 6; Reut., Medd. Faun. Flor Fenn., v. (1880), 208 and 220.

Greyish yellow; nerves of the elytra whitish. Crown two-thirds longer in the middle than at the sides, subequal in length to the pronotum, its free sides straight, and the angle pointed; inter-ocular line not interrupted in the middle, forked at each end, the lower branch joining the basal spot; interocellar line entire; infra-ocellar line obsolete or wanting. Pronotum and scutellum sometimes with a few fuscous markings. Elytra a little shorter than the abdomen, narrowly rounded at the apex, in the macropterous form as long as or a little longer than the abdomen, with the suture and some of the areas narrowly margined with blackish, and the apical areas more or less filled up with the same colour. Hind margin of the last ventral segment in the female sub-angularly concave, with a bifid process in the middle. Length, 5—5½ mm.

Moderately common amongst grasses, May to July. An entirely pale form is not unfrequent.

6. *Athysanus communis*, J. Sahl.

Athysanus communis, J. Sahl. (MS.)
Jassus plebejus, Flor, Rhyn. Liv., ii., 291, 10; Kirschb., Cicad., 111, 54.
Athysanus plebejus, Kirschb., Athys. Art., 8, 6; Scott, Ent. Mo. Mag., xii., 98, 8.

Pale brownish yellow; elytra sparingly speckled with black along the nerves; transverse nerve and the apices of the anal and axillary nerves milk-white. Crown in the male as long as half its basal width, one-half longer in the middle than at the sides; in the female a little shorter than half its basal width, twice as long in the middle as at the sides; the free margin in the male sub-parallel with the curve of the hind margin, in the female forming an obtuse but distinct angle. Pronotum about two-thirds longer than the crown. Markings on the crown precisely similar in form to those of *A. obscurellus*, but in point of intensity only equal to the female of that species. Frons pale, with black transverse lines, its middle line pale at least below. Elytra as long as or a little shorter than the abdomen, widely rounded at the apex; nerves whitish. Abdomen above black, margins of the segments narrowly yellow, under side black, with a row of yellow spots down each side, or yellow, with a wide more or less interrupted black stripe down the middle. Legs striped and spotted with black; thighs only occasionally with a black band near the apex. Length, 4—5¼ mm.

Common amongst grasses, especially in damp places. Very closely allied to *A. obscurellus*, but distinguishable by its larger size, wider and more obtuse form, paler colour, and the milk-white spots on the elytra.

7. *Athysanus obscurellus*, Kbm.

Athysanus obscurellus, Kirschb., Athys. Art., 10, 11; Cicad., 115, 64; Scott, Ent. Mo. Mag., xii., 98, 9.
Acocephalus agrestis, Marsh., Ent. Mo. Mag., ii., 197, 7.

Brownish yellow; elytra closely and finely speckled with black. Crown subequal in length to half its basal width, nearly one-half longer in the middle than at the sides, its free sides gently arcuate, the angle obtuse; basal markings annular; the interocular line thickened and more or less widely interrupted in the middle; interocellar line broken up into four spots; infraocellar line biarcuate, well-defined. Frons black, the usual lines yellow.

Pronotum one-third longer than the crown, with a few black spots in front, behind with four dark stripes, each composed of short transverse black lines. Scutellum with some black spots. Elytra gently rounded at the sides, a little longer than the abdomen, widely rounded at the apex; nerves a little paler than the disc. Abdomen black. Legs striped, spotted, and banded with black. In the female the crown is nearly twice as long in the middle as at the sides, the speckling on the elytra is confined to a little along the nerves, the other dark markings are much reduced, and the frons is brownish yellow, with a double black middle stripe and black or fuscous transverse lines. Length, 3—3½ mm.

Very abundant in grassy places. The male is easily recognised by its small size and dusky appearance, but the female is liable to be confounded with *A. communis*, from which it is best separated by its narrower, more pointed form, and the absence of milk-white spots on the elytra.

8. *Athysanus obsoletus*, Kbm.

Athysanus obsoletus, Kirschb., Athys. Art., 7, 4; Cicad., 109, 50; Scott, Ent. Mo. Mag., xii., 97, 7.
A. sexpunctatus, J. Sahl., Not. Fenn., xii., 271, 8.
A. piceus, Scott, Ent. Mo. Mag., xii., 97, 6.

Greyish yellow; crown with six black points placed in two oblique lines meeting in the apex. Crown in the male as long as half its basal width, two-thirds longer in the middle than at the sides; in the female a little longer than half its basal width, one-half longer in the middle than at the sides, its free sides gently arcuate, the angle obtuse; basal markings punctiform, close to the eyes; interocular line thickened and widely interrupted in the middle, most frequently represented by a pair of spots on the disc; interocellar line thickened and interrupted in the middle, often broken up into four spots, and most frequently represented by a pair of spots on the apex; infraocellar line obsolete or wanting. Frons yellow, with black transverse lines. Pronotum three times (♀) or nearly three times (♂) as long as the crown. Elytra variable in length, in the prevalent form with scarcely any traces of black speckling along the whitish nerves. Abdomen in the male black, with the connexivum yellow; in the female yellow, with an acuminate black middle stripe on both upper and under sides; hind margin of the last ventral segment (♀) concave, with a blunt triangular tooth in the middle. Legs striped and spotted with black; intermediate thighs with a black band before the apex. Length, 4½—5½ mm.

Very abundant in damp grassy places. Of the same robust build as *A. grisescens*, but easily distinguished by the markings on the crown. The dark form (*A. piceus*, Scott) has the frons black, with yellow transverse lines; the crown (by reason of the exaggeration and confluence of the normal markings) black, with a few yellow spots, or entirely black; and the pronotum, scutellum, and elytra lighter or darker pitch-brown, in the latter owing to the close black speckling, after the manner of *A. obscurellus*, male.

9. *Athysanus melanopsis*, Hardy.

Aphrodes melanopsis, Hardy, Trans. Tynes. Field Club, i., 427, 3.

Thamnotettix melanopsis, Scott, Ent. Mo. Mag., xii., 23, 4.

T. Scotti, Fieb., Cicad. d'Eur. (*Thamnotettix*), 66, 7.

Brownish yellow; areas of the elytra often narrowly margined with fuscous or black. Crown one-half longer than half its basal width, one-half longer in the middle than at the sides, its free sides nearly straight, angle distinct but obtuse; basal markings large, horseshoe-shaped; interocular line interrupted, but scarcely thickened in the middle, often broken up into four spots, on the hinder half of the disk a pair of whitish stripes narrowly margined with fuscous reaching as far as the interocular line; interocellar line broken up into four spots; infraocellar line biarcuate, very distinct. Frons black, with a middle stripe and the transverse lines yellow. Pronotum a little longer than the crown, sometimes with four wide dark stripes. Scutellum yellow, generally without markings. Elytra in the male a little longer, in the female a little shorter, than the abdomen, narrowly rounded at the apex, the areas frequently more or less distinctly ocellate, but very often without markings; nerves pale. Abdomen black; hind margins of the dorsal segments narrowly whitish behind. Last ventral segment (♀) a little longer than the preceding, its hind margin simple, very feebly concave. Legs black, the knees and the outer side of the tibiæ for some distance from the base brownish yellow. Length, 3 mm.

Widely distributed, but not very common. Easily distinguished by its small size and Deltocephaloid facies; it forms, in fact, a connecting link between the genera *Athysanus* and *Deltocephalus*, if we pass to the latter by way of *D. pulicaris*.

iii. Deltocephalus, *Burm.* (Pl. III., fig. 13).

Burmeister, Gen. Ins., ii. (1838).

Body oblong or elongate. Head with the eyes as wide as the pronotum, pointed in front; crown flat or slightly convex, more or less angularly produced in front; frons at the apex three or four times as wide as the temples; cheeks generally subangularly dilated; temples linear; ocelli somewhat distant from the eyes. Side margins of pronotum short. Elytra usually subcoriaceous, with five subapical areas, generally shorter than the abdomen with very short apical areas, sometimes longer than the abdomen in consequence of the development of the membrane and appendix, and in that case the elytra overlap a little at the apex. Wings often very short.

Table of Species.

1 (36).	Crown flat or slightly depressed.	
2 (35).	Elytra without a black spot at the apex of the fourth subapical area.	
3 (10).	Elytra green, greyish green, or yellow (dark margins to the areas exceptional in this group).	
4 (5).	Corium opaque throughout; apical areas sometimes with dark hind margins ..	1. *abdominalis.*
5 (4).	Corium never entirely opaque; elytra generally transparent.	
6 (7).	Frons with a wedge-shaped yellowish-white stripe reaching from the forehead to the clypeus	2. *striifrons.*
7 (6).	Frons without a yellowish-white stripe.	
8 (9).	Genital plates reaching nearly three times as far as the valve; hind margin of the last ventral segment in the female concave, with a deep acutangular notch in the middle	3. *pascuellus.*
9 (8).	Genital plates reaching only twice as far as the valve; hind margin of the last ventral segment in the female nearly straight ..	4. *citrinellus.*
10 (3).	Species lighter or darker brownish yellow or greyish or ochreous white. Nerves frequently wholly or partly milk-white (dark margins to the areas of frequent occurrence in this group).	
11 (12).	Clavus divided into several small areas ..	5. *ocellaris.*
12 (11).	Clavus not divided into small areas.	
13 (30).	♂; genital plates not shorter than the valve: ♀; hind margin of the last ventral segment toothed or notched or triangularly produced.	

14 (15). Front margin of crown with four or six equidistant black spots, or a black band bearing three or five pale spots .. .. 6. *coronifer.*

15 (14). Crown not as above.

16 (29). ♂; side lobes of pygofer more or less pointed, not connivent: ♀; hind margin of the last ventral segment without a triangular notch in the middle.

17 (24). All or most of the areas of the elytra margined with fuscous.

18 (23). All the areas, including the basal one, margined with fuscous.

19 (20). Nerves concolorous .. .. 7. *repletus.*

20 (19). Nerves white.

21 (22). Fuscous margins of the areas regular .. 8. *oculatus.*

22 (21). Fuscous margins of the areas irregular .. 9. *picturatus.*

23 (18). Nearly all the areas, except the basal one, irregularly margined with fuscous .. 10. *Flori.*

24 (17). The fuscous markings of the elytra either confined to a narrow border to the apical areas, and one or two spots on the corium, or entirely wanting.

25 (26). Outline of the hind margin of the last ventral segment in the female resembling an ogee arch .. .. 11. *Linnei.*

26 (25). Not as above.

27 (28). Hind margin of the last ventral segment in the female with an angular notch on each side .. .. 12. *distinguendus.*

28 (27). Hind margin of the last ventral segment in the female feebly trisinuate .. .. 13. *Falleni.*

29 (16). ♂; side lobes of pygofer wide, inflexed, and connivent: ♀; hind margin of the last ventral segment with a small triangular notch in the middle .. .. .. 14. *socialis.*

30 (13). ♂; genital plates very short, distinctly shorter than the valve: ♀; hind margin of the last ventral segment simple, faintly concave or straight.

31 (34). The three innermost apical areas not white.

32 (33). Elytra with five or six distinct black spots. Inhabits coast-sands .. .. .. 15. *sabulicola.*

33 (32). Elytra not spotted, the inner areas more or less bordered, sometimes entirely filled up with black or brown. Abundant everywhere .. .. 16. *striatus.*

34 (31). The costal and three innermost apical areas white .. .. 17. *Normani.*

35 (2). Elytra with a small black spot at the apex of the fourth subapical area .. .. 18. *punctum.*

36 (1). Crown distinctly though slightly convex.

37 (38). Elytra with two broad white bands .. 19. *argus.*

38 (37). Elytra not banded with white.

39 (40). Membrane with two distinct black spots, one in the first and the other in the fourth apical area .. .. 20. *costalis.*

40 (39). Membrane without black spots.

41 (42). Front of crown with a black band bearing five white spots .. .. 21. *coroniceps.*

42 (41). Crown not as above.

43 (44). Crown with two round black spots.. .. 22. *maculiceps.*

44 (43). Crown without round black spots .. .. 23. *pulicaris.*

1. *Deltocephalus abdominalis*, Fab.

Cercopis abdominalis, Fab., Sys. Rhyn., 98, 61.
Cicada bicolor, Fieb., Ent. Sys., iv., 40, 55.
C. abdominalis, Fall., Hem. Suec., ii., 31, 10; Zett., Ins. Lapp., 290, 6.
C. balteata, Zett., Ins. Lapp., 290, 8.
Jassus abdominalis, Germ., Faun. Ins. Eur., xvii., t. 19; H.-Scff., Deuts. Ins., 125, 4; Thoms., Opusc., Ent., i., 66, 45.
Aphrodes juvenca, Hardy, Trans. Tynes. Field Club, i., 425, 2 (pars.).
Deltocephalus abdominalis, Flor, Rhyn. Liv., ii., 249, 9; Marsh., Ent. Mo. Mag., ii., 265, 9; Kirschb., Cicad., 129, 89; Fieb., Syn. Eur. Delt., 15, 40, fig. 40; J. Sahl., Not. Fenn., xii., 328, 21; Scott, Ent. Mo. Mag., xii., 242, 6.

Upper side greenish yellow or greyish green; hind margins of the apical areas frequently fuscous. Crown distinctly shorter than its width at the base, nearly twice as long in the middle as at the sides, the free sides straight, angle blunt. Frons black, with yellow transverse lines; apical half sometimes yellow, with a double black middle stripe. Pronotum about one-third shorter than the crown, Elytra coriaceous, as long as or a little longer than the abdomen, widely rounded at the apex; membrane and the apices of the subapical areas whitish, subpellucid; nerves yellow. Legs yellow, striped, spotted, and banded with black; hind tarsi black, yellow at the base. ♂; abdomen black; genital plates separately rounded at the apex, their outer margin angularly excised on the apical third, their inner margin about one and a half times as long as the valve; pygofer reaching beyond the plates. ♀; abdomen above black, below yellow spotted with black; last ventral segment black, sides and hind margin more or less widely yellow, the latter with a longitudinally striate depression on each side and a pair of triangular teeth in the middle. Length, 4—4½ mm.

Not uncommon. Fieber's figure of the male genitalia seen from below, is not characteristic. J. Sahlberg speaks of red or reddish varieties of this species, but I have not seen British specimens of these.

2. *Deltocephalus striifrons*, Kbm.

Deltocephalus striifrons, Kirschb., Cicad., 139, 12; J. Sahl., Not. Fenn., xii., 327, 20; Ferrari, Cicad. agri. Ligust. 72, 20, and 74, 154.

D. Mulsanti, Fieb., Syn. Eur. Delto., 16, 45, fig. 44; Scott, Ent. Mo. Mag., xii., 240, 2.

D. longicaput, Scott, Ent. Mo. Mag., xii., sec. spec. typ.

Oblong. Upper side bright yellow; three narrow stripes on the crown, five on the pronotum, and the basal half of the costa, white; a pair of short black lines on the apex of the crown. Crown in the male as long, in the female one-fourth longer, than its width at the base, about one-third longer in the middle than at the sides, the free sides nearly straight, angle pointed. Frons black, with whitish transverse lines, its central space occupied by a large whitish-yellow triangle, of the same width at the base as the clypeus, and reaching thence to the forehead; infraocellar line broad, gently curved, and very well-defined, interrupted in the middle, and joined to the two short lines on the apex of the crown which represent the interocellar line. Pronotum about one-third shorter than crown. Elytra about as long as the abdomen, coriaceous on the basal half, afterwards subpellucid; nerves whitish. Legs yellow, striped, banded, and spotted with black. ♂; abdomen black, sides and apex yellow; genital plates yellow, reaching as far as the pygofer, separately rounded at the apex, their inner margin at least two and a half times as long as the valve, each one bearing a longitudinal impressed line, which is subparallel with the outer margin. ♀; abdomen above yellow; a few of the basal segments black in the middle; under side yellow, with a wide black middle stripe, or entirely black; last ventral segment yellow, its hind margin semicircularly concave, with a deep narrow black-bordered angular notch in the middle. Length, $3\frac{1}{2}$—$3\frac{3}{4}$ mm.

Not common. Amongst *Ononis* on the south coast. According to Reuter it is found on *Trifolium*.

3. *Deltocephalus pascuellus*, Fall.

Cicada pascuella, Fallen, Hem. Suec., ii., 32, 11.
Jassus pascuellus, Thoms., Opusc. Ent., i., 70, 54.
Deltocephalus pascuellus, Flor, Rhyn. Liv., ii., 251, 10; Marsh., Ent. Mo. Mag., ii., 267, 11; Kirschb., Cicad., 138, 108; Fieb., Syn. Eur. Delto., 16, 44, fig. 46; J. Sahl., Not. Fenn., xii., 325, 18; Scott, Ent. Mo. Mag., xii., 244, 9.
D. luteolus, Kirschb., Cicad., 138, 109.
D. fuscosignatus, Dahl., Vet. Ak. Handl., 1850, 195.
D. Minki, Fieb., Syn. Eur. Delto., 17, 46, fig. 45; Scott, Ent. Mo. Mag., xii., 243, 8; Ferrari, Cicad. agri. Ligust., 72, 21.

Elongate. Upper side pale yellow; apical areas and those adjoining frequently margined with fuscous; costa yellowish white; interocellar line represented by two or four black or fuscous spots. Crown in the male as long, in the female a little longer, than its width at the base, about one-third longer in the middle than at the sides, free sides distinctly arcuate, angle blunt. Frons black or brown, with a few curved transverse whitish lines down each side; infraocellar line represented by a black V near the middle of the forehead, the ends of which sometimes merge into the ground colour of the frons. Pronotum very little shorter than the crown. Elytra subpellucid, a little longer than the abdomen in the male, a little shorter in the female, widely rounded at the apex; nerves yellow. Legs pale yellow, striped, spotted, and banded with black. ♂; abdomen black, sides and apex yellow; genital plates yellow, basal half black, long, triangular, separately rounded at the apex, their inner margin rather more than twice as long as the valve; on the basal two-thirds of each a longitudinal impressed line. ♀; abdomen coloured as in *D. striifrons*; hind margin of the last ventral segment gently concave, with a deep angular notch in the middle. Length, 3—3½ mm.

Very common amongst grasses in damp places. Judging from a type received from Dr. Puton, this is clearly *D. Minki*, Fieb., and if we imagine the processes of the lower margins of the male pygofer to be half sagittate at the apex instead of simple, Fieber's figure (*l. c.*, fig. 45, *e*) would well represent that portion of our insect. I have taken both sexes on July 2nd, and immature examples and nymphs as late as Sept. 30th.

4. *Deltocephalus citrinellus*, Kbm.

Deltocephalus citrinellus, Kirschb., Cicad., 134, 100; J. Sahl., Not. Fenn., xii., 334, 25.

Jassus cephalotes, H.-Scff., Deuts. Ins., 125, 6.

Deltocephalus cephalotes, Ferrari, Cicad. agri. Ligust., 72, 19.

D. assimilis, Fieb., Syn. Eur. Delto., 16, 43, fig. 41; Scott, Ent. Mo. Mag., xii., 243, 7.

D. brachynotus, Fieb., *l. c.*, 19, 55, fig. 55.

Oblong-ovate. Upper fore parts greenish yellow, elytra pale greyish green, breast black. Crown subequal in length to its width at the base, nearly twice as long in the middle as at the sides, free sides nearly straight, angle blunt; interocellar line when present fuscous. Frons pale brown, with a middle stripe and the usual side lines yellow. Pronotum about one-third shorter than the crown. Elytra whitish hyaline at the apex, a little longer than the abdomen, costa rounded, apex widely rounded; nerves stout, yellow, inner apical areas and those adjoining sometimes narrowly margined with fuscous. Legs yellow, striped and spotted with black. ♂; abdomen black; genital plates very small, separately rounded, scarcely half as long as the trapeziform valve. ♀; abdomen black, with the sides more or less widely yellow; last ventral segment yellow at the sides or entirely yellow, its hind margin nearly straight. Length, 2¾—3¼ mm.

Moderately common amongst grasses in damp places.

5. *Deltocephalus ocellaris*, Fall.

Cicada ocellaris, Fall., Hem. Suec., ii., 33, 13; Zett., Ins. Lapp., 291, 11.

Jassus ocellatus, H.-Scff., Deuts. Ins., 129, 11; Germ., Faun. Ins. Eur., xvii., 18.

Deltocephalus ocellaris, Flor, Rhyn. Liv., ii., 237, 3; Marsh., Ent. Mo. Mag., ii., 223, 2; Kirschb., Cicad., 141, 115; Thoms., Opusc. Ent., i., 72, 59; Fieb., Syn. Eur. Delto., 5, 9, fig. 9; J. Sahl., Not. Fenn., xii., 310, 7; Scott, Ent. Mo. Mag., xii., 275, 16; Ferrari, Cicad. agri. Ligust., 70, 4.

Crown yellowish white with fulvous spots, in the male as long, in the female a little longer, than its basal width, about three-fourths longer in the middle than at the sides, free sides feebly arcuate, angle blunt. Frons blackish brown, sometimes with a large yellow patch on the apical half; side lines short, whitish.

Pronotum one-third or less shorter than the crown, fulvous, with three or five narrow yellowish white stripes. Scutellum yellowish white, with fulvous spots. Elytra dirty yellow, obliquely subtruncate at the apex; nerves white, the transverse ones and those at the base and apex of the first subapical area dilated; clavus divided into several small areas, which, together with those of the corium and membrane, are margined with black. Abdomen black, yellow at the apex. Legs: thighs black, yellow at the apex; tibiæ yellow with black points, hind pair widely black on the inner side. ♂; elytra somewhat longer than the abdomen; genital plates elongate, triangular, reflexed, subnavicular, with a common narrow oval impression at the apex. ♀; elytra shorter than the abdomen; hind margin of the last ventral segment with a strong triangular, sometimes bifid, tooth in the middle. Length, 3—3½ mm.

Very abundant amongst grasses.

6. *Deltocephalus coronifer*, Marsh.

Deltocephalus coronifer, Marsh., Ent. Mo. Mag., ii., 265, 8.

Thamnotettix coronifer, Scott, Ent. Mo. Mag., xii., 24, 8; Ferrari, Cicad. agri. Ligust., 51, 11, and 54, 122; Fieb., Cicad. d'Eur. (*Thamnotettix*), 69, 9.

Brownish yellow. Crown distinctly longer than the pronotum, about twice as long in the middle as at the sides, nearly as long as its basal width; infraocellar line complete, biarcuate, and combining with the interocellar line to form a black band bearing three or five pale spots; cheeks black, with a few pale spots; frons pale, with a few black transverse lines. Elytra about as long as the abdomen, the areas margined with fuscous feebly at the base, more strongly towards the apex; a blackish spot in the base of the third subapical area; nerves white, those at the base and apex of the first subapical area not thickened; one transverse nerve. Basal half of the abdomen blackish. Legs pale, distinctly spotted with black. Length, 3 mm.

Amongst grass beneath furze-bushes at Esher, in September. The above description is taken from the Rev. T. A. Marshall's original examples. I have seen no recent specimens.

7. *Deltocephalus repletus*, Fieb.

Deltocephalus repletus, Fieb., Syn. Eur. Delto., 8, 20, fig. 20; Scott, Ent. Mo. Mag., xviii., 66; Ferrari, Cicad. agri. Ligust., 70, 9.

Narrow, parallel-sided. Crown one-third longer than its basal width, twice as long in the middle as at the sides, free sides feebly arcuate, angle pointed; yellow-brown becoming whitish in front, four spots representing the interocellar line and two on the disk fuscous or blackish. Frons blackish brown, the side lines and sometimes a middle stripe on the lower half yellowish. Pronotum one-third shorter than the crown, yellow-brown, with three or five more or less distinct linear white stripes, sometimes with a blackish spot on each side. Elytra yellow-brown, much longer than the abdomen, the membrane well-developed, all the areas regularly margined with fuscous; nerves concolorous, the dilated ones at the base and apex of the first subapical area and the apices of those in the clavus scarcely whitish. Abdomen black, upper side more or less widely yellow at the apex. Legs brownish yellow, striped, spotted, and banded with black.

Scarce. Forres (*Norman*); I have taken it singly in three localities in Norfolk.

8. *Deltocephalus oculatus*, J. Sahl.

Deltocephalus oculatus, J. Sahl., Not. Fenn., xii., 308, 6; Scott, Ent. Mo. Mag., xii, 274, 15.

Narrow, parallel-sided; eyes large and prominent. Upper side yellowish; a short oblique line on each side of the apex of the crown, the hind part of the disc of the pronotum, some markings on the scutellum, and wide margins to the areas of the elytra, fuscous. Crown strongly angularly produced, nearly twice as long in the middle as at the sides. Eyes one-fifth longer than half the front margin of the crown. Frons blackish brown, with very short pale side-lines; clypeus yellow, with a fuscous middle stripe. Pronotum somewhat shorter than the crown. Elytra shining, somewhat longer than the abdomen, elongate, parallel-sided, obtusely rounded at the apex, the strongly thickened nerves and two spots on the suture white; all the areas widely margined with fuscous. Abdomen black, its sides and the margins of the segments yellow. Legs yellow, spotted and striped with fuscous. Length, 3½ mm.

Rare. One or two examples in Scott's collection, labelled by J. Sahlberg. Evidently closely allied to the preceding form, from which it is mainly distinguished by its white nerves.

9. *Deltocephalus picturatus*, Fieb.

Deltocephalus picturatus, Fieb., Syn. Eur. Delto., 9, 23, fig. 23; Ferrari, Cicad. agri Ligust., 71, 11, and 73, 151.

Narrow, parallel-sided. Crown one-third longer than its basal width, twice as long in the middle as at the sides, free sides nearly straight, angle pointed; white, with large blotches of pale rust-brown, the interocellar line broken up into four blackish lines. Frons blackish brown, the apex narrowly, a fine linear middle stripe on the lower half, and the side-lines, whitish. Pronotum about one-third shorter than the crown, pale brown, with three or five linear white stripes, and sometimes a blackish spot on each side. Elytra yellow-brown, much longer than the abdomen, the membrane well-developed, all the areas strongly and irregularly margined with fuscous, the basal one filled up with that colour; nerves milk-white, strongly and irregularly dilated; the scutellar margin and two roundish spots at the apices of the nerves of the clavus white. Abdomen black, upper side yellow at the apex. Legs greyish yellow, striped, banded, and spotted with black. Length, 3—3½ mm.

Scarce. Pitlochry, Perthshire; Dunston Common, near Norwich.

10. *Deltocephalus Flori*, Fieb.

Deltocephalus Flori, Fieb., Syn. Eur. Delto., 10, 25, fig. 25; Scott, Ent. Mo. Mag., xviii., 67; Ferrari, Cicad. agri Ligust. 71, 12.

Crown a little longer than its basal width, about twice as long in the middle as at the sides, free sides nearly straight, angle pointed; white, with some large rust-yellow blotches occupying almost all the disc. Frons blackish brown, a linear middle stripe on the lower half, the apex narrowly and the subclavate side-lines whitish. Pronotum one-third or more shorter than the crown, rust-yellow, with five linear white stripes. Elytra brownish yellow, subequal in length to the abdomen, widely rounded at the apex; membrane well-developed; areas with the exception,

generally, of the costal, subcostal, and basal, feebly and irregularly margined with fuscous; nerves milk-white, the transverse ones, the apices of those in the clavus, and those at the base and apex of the first subapical area much dilated. Abdomen black, upper side more or less widely yellow at the apex. Legs greyish yellow, banded, striped, and spotted with black. Length, 3 mm.

Amongst long grass in woods, &c.; not very common.

11. *Deltocephalus Linnei*, Fieb.

Deltocephalus Linnei, Fieb., Syn. Eur. Delto., 14, 35, fig. 35.

D. I-album, Scott, Ent. Mo. Mag., xviii., 137 (orig.).

Crown a little longer than its basal width, nearly twice as long in the middle as at the sides, free sides feebly arcuate, angle pointed; yellowish white, with some rust-yellow blotches. Frons black, its lower half and the usual transverse side-lines yellow. Pronotum about one-third shorter than the crown, rust-yellow, with five more or less distinct linear white stripes. Elytra pale brownish yellow, as long or longer than the abdomen, some of the areas, especially on the apical half, narrowly margined with fuscous; nerves milk-white, the first transverse nerve much thickened. Legs yellow, striped, spotted, and banded with black. ♂; pygofer reaching a little beyond the genital plates, the inner margin of the latter about twice as long as the valve. ♀; abdomen black, apical half yellow, outline of the hind margin of the last ventral segment resembling an ogee arch. Length, 4—4½ mm.

Rare. Near Hastings.

12. *Deltocephalus distinguendus*, Flor.

Deltocephalus distinguendus, Flor, Rhyn. Liv., ii., 240; Fieb., Syn. Eur. Delto., 9, 21, fig. 21; Scott, Ent. Mo. Mag., xviii., 67; Ferrari, Cicad. agri Ligust., 70, 10.

D. pseudocellaris, Flor, *l. c.*, 547; Thoms., Opusc. Ent., i., 73, 61; J. Sahl., Not. Fenn., xii., 314, 10.

D. propinquus, Edwards, Ent. Mo. Mag., xx., 208 (nec Fieb.).

Crown a little longer than its basal width, twice as long in the middle as at the sides, free sides straight, angle pointed; yellow, sometimes with two brown patches on the disc; interocellar line represented by a point at each ocellus, and a pair of short oblique

lines on the apex of the crown. Pronotum little more than half as long as the crown, yellow, with three or five more or less distinct linear white stripes. Scutellum yellow. Elytra greyish yellow, as long or a little longer than the abdomen, subtruncate at the apex, their hind margin, the apical half of the costa, and some of the areas narrowly margined with fuscous or black; nerves white, but, with the exception of the dilated ones at the base and apex of the first subapical area, not conspicuously milk-white. Abdomen black, more or less widely yellow at the apex. Legs yellow, with black points and linear stripes and bands. ♂; genital valve short, triangular, one-half longer than the last ventral segment; plates reflexed, elongate-triangular, three times as long as the valve, outer margins sinuate, apices separately rounded; side lobes of the pygofer much shorter than the plates, and somewhat shorter than the anal tube, in the middle of the lower margin a strong tooth. ♀; last ventral segment twice as long as the preceding, with an angular notch on each side, middle lobe wide, subtrapeziform, side lobes triangular, shorter than the middle one. Length, 2¾—3 mm.

With the exception, perhaps, of *D. striatus*, this is the commonest species of the genus with us. The notches in each side of the hind margin of the last ventral segment of the female are subject to much variation in degree, and in those examples where they are least developed the hind margin appears to bear two small triangular teeth, which are about equidistant from the sides and from each other.

13. *Deltocephalus Falleni*, Fieb.

Deltocephalus Falleni, Fieb., Syn. Eur. Delto., 10, 24, fig. 24; J. Sahl., Not. Fenn., xii., 315, 11; Scott, Ent. Mo. Mag., xii., 271, 11.

Scarcely distinguishable from the preceding, except by the characters of the genitalia. ♂; genital plates reflexed, three times as long as the valve, sinuate on their outer margin, and obtusely rounded at the apex; side lobes of pygofer scarcely shorter than the anal tube, but somewhat shorter than the plates, a small incurved tooth at the apex, and a strong tooth in the middle of the lower margin. ♀; last ventral segment nearly twice as long as the preceding, its hind margin feebly trisinuate, the intermediate sinus wider and not so deep as the lateral ones, the lateral angles somewhat obtuse. Length, 2¾—3 mm.

Widely distributed, but not common. There seems to be room for considerable doubt whether this species is really distinct from the preceding.

14. *Deltocephalus socialis*, Flor.

Deltocephalus socialis, Flor, Rhyn. Liv., ii., 242, 5; Marsh., Ent. Mo. Mag., ii., 250, 4; Kirschb., Cicad., 143, 118; Fieb., Syn. Eur. Delto., 5, 8, fig. 8; J. Sahl., Not. Fenn., xii., 312, 8; Scott, Ent. Mo. Mag., xii., 273, 14; Ferrari, Cicad. agri Ligust., 69, 3.

D. quadrivittatus, Marsh., *l. c.*, 221, 1.

Jassus socialis, Thoms. Opusc. Ent., i., 73, 60.

Crown a little longer than its basal width, nearly twice as long in the middle as at the sides, free side very feebly arcuate, angle blunt; white, with rust-yellow blotches; interocellar line represented by a point near each ocellus, and a pair of triangular black spots on the apex. Frons brown, the side-lines, a middle stripe on the lower half, and the apex, yellow. Pronotum one-third to one-half shorter than the crown, pale brown, with five linear white stripes. Elytra dirty yellow, shorter than the abdomen, widely rounded at the apex; nerves white, but not anywhere dilated, the areas, especially towards the apex, faintly margined with fuscous. Abdomen above yellow, its basal half, a linear stripe down each side, and some traces of a double line down the middle, black; upper side of the pygofer in the male with a large roundish black spot on each side. Legs yellow, with black points and narrow black bands and stripes. ♂; genital plates rather more than twice as long as the valve, yellow, each bearing a large black patch at its separately rounded apex; lateral lobes of the pygofer inflexed, connivent. ♀; hind margin of the last ventral segment rather strongly concave, with a small angular black-bordered notch in the middle, not reaching half the length of the segment. Length, 2¾—3 mm.

Widely distributed, but local. In the macropterous form all the areas of the elytra are more or less broadly margined with black.

15. *Deltocephalus sabulicola*, Curt.

Aphrodes sabulicola, Curt., Brit. Ent., p. and pl. 633.

Deltocephalus sabulicola, Marsh., Ent. Mo. Mag., ii., 251, 7; Fieb., Syn. Eur. Delt., 12, 29, fig. 29; Scott, Ent. Mo. Mag., xii., 272, 12.

D. arenicola, J. Sahl., Not. Fenn., xii., 343, 32.

Crown distinctly shorter than its basal width, about one-half longer in the middle than at the sides, free sides feebly arcuate, angle blunt; yellowish white, the markings when present rust-brown, ill-defined, and frequently coalescent. Frons pale brown, the lower half and the side-lines yellowish white. Pronotum a little shorter than the crown, pale brown, with three or five linear white stripes. Elytra much longer than the abdomen, greyish yellow, with a few isolated black spots, of which the following are the most constant, *viz.*, one on the basal third of the clavus next the claval suture, one at the base of the supra-brachial area, and one at the apex of the third subapical area, inner margin of the clavus, except the basal third, narrowly black, and the third apical area more or less filled up with the same colour; nerves milk-white, the transverse ones dilated. Abdomen black, sides and apex more or less widely yellow. Legs greyish yellow, with a few black points. Genitalia very similar to those of the next species. Length, 4 mm.

Very common on coast-sands.

16. *Deltocephalus striatus*, Lin.

Cicada striata, Lin., Faun. Suec., ed. ii., 241, 887; Schrank, Enum. Ins. Aust., 256, 492; Fab., Sys. Rhyn., 77, 74; Fall., Hem. Suec., ii., 35, 17; Zett., Ins. Lapp., 291, 13.

Jassus striatus, H.-Scff., Deuts. Ins., 130, 10; Thoms., Opusc. Ent., i., 70, 53.

J. strigatus, Germ., Mag. d'Ent., iv., 92, 33.

Deltocephalus striatus, Flor, Rhyn. Liv., ii., 259, 14; Marsh., Ent. Mo. Mag., ii., 250, 5; Kirschb., Cicad., 132, 96; Fieb., Syn. Eur. Delt., 13, 32, fig. 32; J. Sahl., Not. Fenn., xii., 339, 28; Scott, Ent. Mo. Mag., xii., 272, 13; Ferrari, Cicad. agri Ligust., 71, 16, and 74, 153.

Crown and pronotum as in *D. sabulicola*. Frons brown, the apex narrowly, a linear middle stripe, and the side-lines, whitish. Elytra greyish yellow, much longer than the abdomen, the areas of the inner half more or less distinctly margined with fuscous, the third apical area frequently filled up with the same colour; nerves white, the transverse ones not conspicuously dilated. Abdomen black, sometimes yellow at the sides and apex. Legs greyish yellow, with some black points; hind tibiæ narrowly striped with black. ♂; genital plates very small and short,

separately pointed, less than half as long as the trapeziform genital valve. ♀; hind margin of the last ventral segment simple, feebly concave. Length, $3\frac{1}{4}$—$3\frac{1}{2}$ mm.

Very abundant amongst grasses in a variety of situations. Varieties in which the inner areas of the elytra are entirely filled up with black are not uncommon. The salt-marsh form is smaller, with the elytra scarcely as long as the abdomen, and hardly any traces of dark margins to the areas.

17. *Deltocephalus Normani*, Scott.

Deltocephalus Normani, Scott, Ent. Mo. Mag., xviii., 105.

♂. Closely allied to *D. striatus*, to the pale forms of which it bears a very great resemblance. Upper side very pale yellow-brown, a stripe down the middle of the crown and pronotum, and the costal and three innermost apical areas, white. Elytra as long as the abdomen. The genital valve and plates are like those of *D. striatus*, save that the apices of the latter in the original example are a trifle more oblique within. ♀; elytra shorter than the abdomen; nerves of the clavus dark brown. Length, 3—$3\frac{1}{2}$ mm.

"High heathery land in Morayshire" (one male, two females). The shape of the last ventral segment in the female is undescribed, and I have not been able to examine a specimen of that sex. The insect is probably one of the many forms of *D. striatus*.

18. *Deltocephalus punctum*, Flor.

Deltocephalus punctum, Flor, Rhyn. Liv., ii., 247, 8; Marsh., Ent. Mo. Mag., ii., 251, 6; Kirschb., Cicad., 146, 25; J. Sahl., Not. Fenn., xii., 320, 14; Scott, Ent. Mo. Mag., xii., 271, 10.
D. costalis, Fieb., Syn. Eur. Delt., 4, 4, fig. 4.

Crown almost one-third longer than its basal width, nearly twice as long in the middle as at the sides, free sides straight, angle pointed; yellowish grey with three linear white stripes, interocellar line represented by a very fine fuscous line on each side of the apex. Frons yellowish grey, the interstices of the white side-lines brown. Pronotum about one-half as long as the crown, yellowish grey, with five linear white stripes. Elytra whitish hyaline,

shorter than the abdomen, apical areas short, narrowly margined with fuscous, in the apex of the fourth subapical area a black or fuscous spot, nerves white, not anywhere dilated. Abdomen greyish yellow, upper side near the base and the chief part of the under side black; upper side of the pygofer in the female with a rounded black spot on each side of the base. Legs greyish yellow, with a few black points. Length, $2\frac{1}{4}$—$2\frac{1}{3}$ mm.

Not uncommon amongst fine grasses in dry situations. The macropterous form has the elytra longer than the abdomen, with ample membrane and the hind margin of the apical areas broadly fuscous.

19. *Deltocephalus Argus*, Marsh.

Deltocephalus Argus, Marsh., Ent. Mo. Mag., ii., 223, 3; Fieb., Syn. Eur. Delt., 7, 17, fig. 17; Scott, Ent. Mo. Mag., xii., 276, 18.

Upper side brownish yellow; elytra with two broad white bands, one before and the other behind the middle; base of the supra-brachial area filled up with black. Crown subequal in length to its basal width, nearly twice as long in the middle as at the sides, free sides distinctly arcuate, angle blunt; basal markings sub-annular, interocular line represented by a point near each eye and two short lines placed end to end on the disc, interocellar line broken up into four spots, infraocellar line biarcuate, distinct. Frons black, with yellowish side lines, sometimes with a middle stripe on the lower half, and the apex yellowish. Pronotum slightly longer than the crown, yellow-brown, with three or five linear whitish stripes. Scutellum whitish, with some dusky markings at the base. Elytra longer than the abdomen, feebly rounded at the sides, nerves white, areas generally narrowly margined with fuscous. Abdomen black. Legs pale, banded, striped, and spotted with black. ♂; genital valve very small and short, almost semicircular, not half so long as the separately rounded plates, which scarcely reach half so far as the pygofer. ♀; hind margin of the last ventral segment simple, almost semi-circularly concave. Length, $3-3\frac{1}{2}$ mm.

Amongst grasses; widely distributed, but rare.

20. *Deltocephalus costalis*, Fall.

Cicada costalis, Fall., Hem. Suec., ii., 32, 12.
Jassus costalis, Thoms , Opusc. Ent., i., 69, 52.
Deltocephalus bipunctipennis, Boh., Sv. Ak. Handl., 1845, 261, 51; Fieb., Syn. Eur. Delt., 3, 1, fig. 1; J. Sahl., Not. Fenn., xii., 348, 35.

Elongate; upper side white, elytra towards the apex pale reddish brown, a deep black roundish spot in the first and fourth apical areas. Crown without markings, subequal in length to its basal width, about one-third longer in the middle than at the sides, free sides strongly arcuate, angle blunt. Face, breast, and legs white, the latter with some black points. Pronotum as long as the crown. Elytra parallel-sided, longer than the abdomen, the apex subtruncate; nerves white. Abdomen yellow, more or less marked with black in the middle towards the base both above and below. ♂; genital plates at least three times as long as the valve, with a large common roundish black spot in the middle. ♀; hind margin of the last ventral segment nearly straight, with an angular black-bordered notch in the middle. Length, 3—3½ mm.

Marshes, Ranworth, Sept. 30th, 1886. This is its first record as a British species.

21. *Deltocephalus coroniceps*, Kirschb.

Deltocephalus coroniceps, Kirschb., Cicad., 126, 84.
Thamnotettix coroniceps, Fieb., Cicad. d'Eur. (*Thamnotettix*), 70, 10.

♂. Upper side dirty greyish yellow, with some ill-defined whitish markings on the crown, pronotum, and scutellum; forehead and temples with a black band bearing about nine equidistant whitish spots, of which each ocellus forms one; frons with a few irregular blackish transverse curved lines. Crown a trifle shorter than its basal width, one-half longer in the middle than at the sides, free sides feebly arcuate, angle blunt. Pronotum subequal in length to the crown. Elytra longer than the abdomen; membrane amplé; nerves whitish, feebly and irregularly margined with fuscous. Abdomen pale, with black markings. Genital valve very widely rounded, about half as long as the preceding segment; plates large and wide, their joint outline almost semicircular, and their inner margin rather more than twice as long as the valve. Length, 3½ mm.

Coxford Heath, Norfolk; one example, August, 1887. This insect is clearly a *Deltocephalus* of the *argus* group; it has nothing in common with *D. coronifer*, Marsh., next to which it is placed by Fieber in the genus *Thamnotettix*, except the pattern on the forehead.

22. *Deltocephalus maculiceps*, Boh.

Deltocephalus maculiceps, Boh., Sv. Ak. Handl., 1847, 25, 2; Marsh., Ent. Mo. Mag., ii., 267, 12; Kirschb., Cicad., 124, 80; Fieb., Syn. Eur. Delt., 18, 50, fig. 58; J. Sahl., Not. Fenn., xii., 350, 37; Scott, Ent. Mo. Mag, xii., 241, 4.
Jassus maculiceps, Thoms., Opusc. Ent., i., 74, 63.

Oblong-ovate; upper side dirty greyish yellow, crown with two large roundish black spots in front. Crown as long or shorter than its basal width, about one-third longer in the middle than at the sides, free sides distinctly arcuate, angle very blunt. Frons blackish, with the upper part and the side-lines pale. Pronotum distinctly, sometimes almost one-third, shorter than the crown. Elytra subpellucid, rounded at the sides. Abdomen black, upper side at the apex more or less widely yellow in the female. Legs pale, base of the thighs marked with black, hind tibiæ black, except at the base. ♂; genital plates about three times as long as the valve, their outline paraboloid; elytra much longer than the abdomen. ♀; last ventral segment black, with a subquadrate greyish yellow spot in the middle of its hind margin, or greyish yellow with a pair of wide black stripes converging towards the base; the outline of its hind margin forms two large rounded lobes, separated by a short straight line. Length, 2½ mm.

Not common; my specimens were taken amongst low plants on the more bare parts of a wet heath near Norwich. In highly-coloured examples the costa and inner margin of the elytra are narrowly black, the nerves are brown, and the interocellar line is represented by a pair of black points on the apex of the crown.

23. *Deltocephalus pulicaris*, Fall.

Cicada pulicaris, Fall., Hem. Suec., ii., 34, 15; Zett., Ins. Lapp., 291, 12.
Jassus pulicaris, H.-Scff., Deuts. Ins., 127, 4; Thoms., Opusc. Ent., i., 74, 64.

Deltocephalus pulicaris, Flor, Rhyn. Liv., ii., 266, 18; Marsh., Ent. Mo. Mag., ii., 268, 13; Kirschb., Cicad., 124, 79; J. Sahl., Not. Fenn., xii., 351, 38; Scott, Ent. Mo. Mag., xii., 275, 17; Ferrari, Cicad. agri Ligust., 71, 13 and 73, 152.

D. pulicarius, Fieb., Syn. Eur. Delt., 11, 27, fig. 27.

Oblong-ovate; upper side pale brown, under side and legs black, knees and front tibiæ brownish yellow. Crown in the male as long as, in the female shorter than, its basal width, twice as long in the middle as at the sides, free sides strongly arcuate, angle very blunt; brownish yellow, variously spotted with fuscous or black, or entirely brownish yellow; in well-marked examples the basal markings are present, the interocular line is represented by a pair of black spots on the disc, the interocellar line by two or four black spots, and the infraocellar line is biarcuate. Frons black, with or without a few brownish yellow transverse lines. Pronotum one-third or more shorter than the crown, frequently blackish on the hinder half. Elytra about two-thirds as long as the abdomen, widely rounded behind, apical areas extremely short, suprabrachial area and those adjoining filled up or at least margined with fuscous; not unfrequently the costa is dark fuscous, and all the areas except the costal are filled up with that colour; nerves pale, the transverse ones white. ♂; abdomen black, hind margin of the genital valve white, genital plates about three times as long as the valve, their outer margin slightly sinuate just before the apex. ♀; abdomen black, hind margin of the last dorsal segment white, hind margin of the last ventral segment forming three rounded lobes, of which the middle one is less than half as large as either of the others. Length, 2—2½ mm.

Very common amongst grasses in damp places.

iv. Allygus, *Fieb.* (Pl. III., fig. 21).

Fieber, Cicâd. d'Eur., part i., 123 (1876).

Body oblong, widest across the middle. Crown somewhat convex, with the eyes as wide as the pronotum, evenly rounded in front, not or scarcely longer in the middle than at the sides. Side margins of pronotum sharp, of moderate length, hinder angles obliquely truncate. Elytra convolute at the apex, much longer than the abdomen, with several irregularly-disposed white transverse nerves; appendix ample.

The species of this genus are all very much alike in

facies, but may readily be distinguished by the characters of the genitalia. A valuable notice of these insects, with figures of details, will be found in the 'Cicadina agri Ligustici' of Dr. P. M. Ferrari, p. 60, et seq. (*Jassus*).

TABLE OF SPECIES.

1 (2).	♂; genital plates a little shorter than the valve. ♀; last ventral segment somewhat shorter than the preceding	1. *commutatus*.
2 (1).	♂; genital plates much longer than the valve. ♀; last ventral segment much longer than the preceding.	
3 (4).	Crown with an oblique dark line running inwards from the front margin of each eye ..	2. *modestus*.
4 (3).	Crown without any oblique dark line	3. *mixtus*.

1. *Allygus commutatus*, Fieb.

Allygus commutatus, Fieb., Kat. der Eur. Cicad. (1872), p. 13; Scott, Ent. Mo. Mag., xii., 171, 2.
Jassus atomarius, Flor, Rhyn. Liv., ii., 326, 5; Kirschb., Cicad., 83, 2; Thoms., Opusc. Ent., i., 47, 3.
J. commutatus, Ferrari, Cicad. agri Ligust., 60, 3, and fig., p. 63.
Thamnotettix reticulata, J. Sahl., Not. Fenn., xii., 210, 2.

♂. Genital valve as long as the preceding segment, rounded-triangular; plates shorter than the valve, separately rounded-triangular, and leaving uncovered a piece of the apices of the styles about equal in length to the genital valve; the styles, when viewed from below, appear as two narrow horn-like processes converging at the apex; their real form, which is determinable when viewed from the side is that of a recumbent letter Y, having the upper arm the longer. ♀; last ventral segment a little shorter than the preceding, its hind margin nearly even, with a very feeble arcuate notch in the middle; the lateral angles rounded. Length, 6½ mm.

Rare. Tintern (*T. V. Wollaston*); Norwich, August, 1887, one female beaten out of an elm fence.

2. *Allygus modestus*, Fieb.

Allygus modestus, Fieb., Kat. der Eur. Cicad. (1872), p. 13; Scott, Ent. Mo. Mag., xii., 171, 3; Ferrari, Cicad. agri Ligust., 61, 6 and 65, 143, fig, p. 66.
Jassus atomarius, Marsh., Ent. Mo. Mag., 84, 22.

Crown with the basal markings punctiform, the interocular line is represented by a fine straight line running obliquely inwards from the front angle of each eye half-way to the base, and the interocellar line by a punctiform spot adjoining each ocellus. ♂; genital plates triangular, about three times as long as the triangular genital valve, completely covering the styles. ♀; last ventral segment much longer than the preceding, its hind margin with a very feeble angular notch in the middle; lateral angles much produced. Length, 7 mm.

Widely distributed, but much less common than the next species.

3. *Allygus mixtus*, Fab.

Cicada mixta, Fab., Ent. Sys., iv., 39, 54.
C. reticulata, Fall., Hem. Suec., ii., 40, 24, β.
Jassus mixtus, Fab., Sys. Rhyn., 86, 7; Germ., Mag. d'Ent., iv., 82, 7; Burm., Handb., ii., 111, 2; Flor, Rhyn. Liv., ii., 322, 4; Marsh., Ent. Mo. Mag., iii., 83, 21; Kirschb., Cicad., 84, 3; Thoms., Opusc. Ent., i., 47, 2; Ferrari, Cicad. agri Ligust., 61, 7 and 67, 144, fig.
J. reticulatus, H.-Scff., Deuts. Ins. 130, 11.
Thamnotettix mixta, J. Sahl., Not. Fenn., xii., 209, 1.
Allygus mixtus, Scott, Ent. Mo. Mag., xii., 170, 1.

Crown with the basal markings obsolete, the interocular line represented by a punctiform spot on each side of the disc, and the interocellar line by four punctiform spots. ♂; genital plates triangular, more than twice as long as the triangular genital valve, completely covering the styles. ♀; last ventral segment more than twice as long as the preceding, its hind margin nearly straight; the lateral angles not produced. Length, 6½—7 mm.

Common on oaks. This is a very variable species in the matter of the black speckling of the elytra; sometimes this is very scanty, and at others is so much exaggerated and confluent that the elytra appear deep black with white transverse nerves; immature examples have the upper fore parts tinged with green.

v. Thamnotettix, *Zett.* (Pl. III., fig. 15).

Zetterstedt, Ins. Lapp., 292 (1840).

Body oblong, widest in the middle. Crown somewhat convex, with the eyes about as wide as the pronotum, distinctly produced in front. Frons longer than wide. Pronotum obtusely rounded in front, side margins sharp, of moderate length, hind angles obliquely truncate. Elytra much longer than the abdomen, widened in the middle, overlapping or even convolute at the apex; appendix ample.

Table of Species.

1 (18).	Elytra broadly rounded at apex.	
2 (13).	Side margin of frons from base of antenna to base of clypeus distinctly shorter than the width of the frons between the antennæ.	
3 (12).	One transverse nerve standing on the brachial nerve.	
4 (9).	Etytra not speckled with black.	
5 (6).	Upper side dirty greenish yellow or greyish green, with or without a reddish tinge on the crown, pronotum, and scutellum ..	1. *prasina.*
6 (5).	Upper side greyish yellow or yellow-brown.	
7 (8).	Elytra greyish yellow	2. *dilutior.*
8 (7).	Elytra yellow-brown	3. *subfuscula.*
9 (4).	Elytra greyish yellow, speckled with black.	
10 (11).	Frons with two large black spots above, each formed by the confluence of about three short transverse lines	4. *variegata.*
11 (10).	Frons without large black spots above ..	5. *plebeja.*
12 (3).	Two transverse nerves standing on the brachial nerve	6. *striatula.*
13 (2).	Side margin of frons from base of antenna to base of clypeus longer than the width of the frons between the antennæ.	
14 (17).	Head with the eyes as wide as pronotum.	
15 (16).	Elytra pale yellow speckled with red	7. *cruentata.*
16 (15).	Elytra pale brown, costa widely hyaline ..	8. *Torneella.*
17 (14).	Head with the eyes narrower than the pronotum	9. *splendidula.*
18 (1).	Elytra lanceolate.	
19 (20).	Larger; elytra more pointed at apex, the white markings on the crown and pronotum more distinct, clavus without a distinct black spot	10. *crocea.*
20. 19.	Smaller; elytra less pointed at apex, the white markings on the crown and pronotum less distinct, suture with a small black spot just above the apex of the anal nerve	11. *attenuata.*

1. *Thamnotettix prasina*, Fall.

Cicada prasina, Fall., Hem. Suec., ii., 40, 25.
Jassus simplex, H.-Scff., Deuts. Ins., 125, 7.
J. prasinus, Flor, Rhyn. Liv., ii., 325, 20; Marsh., Ent. Mo. Mag., iii., 103, 26; Kirschb., Cicad., 93, 22; Thoms., Opusc. Ent., i., 48, 72.
Aphrodes sulphureus, Curt., Brit. Ent., 633, 10.
Thamnotettix prasina, Zett., Ins. Lapp., 293, 2.
T. confinis, Zett., *l. c.*, 293, 3.
T. tincta, Zett., *l. c.*, 293, 6.
T. stupidula, Zett., *l. c.*, 294, 9; J. Sahl., Not. Fenn., xii., 216, 8; Edw., Ent. Mo. Mag., xx., 207.
T. simplex, J. Sahl., Not. Fenn., xii., 215, 7.
Athysanns prasinus, Scott, Ent. Mo. Mag., xii., 99, 12; Ferrari, Cicad. agri Ligust., 55, 3 and 60, 137.
A. simplex, Reut., Medd. Faun. Flor. Fenn., v. (1880), 213, 216 and 227, 44; Ferrari, *l. c.*, 55, 4.
A. tinctus, Reut., *l. c.*, 212, 215 and 227, 43.

Upper side greenish yellow or greyish green. Crown in the male as long as half its basal width, about one-half longer in the middle than at the sides, free sides feebly arcuate, angle widely rounded; in the female distinctly longer than half its basal width, nearly twice as long in the middle as at the sides, free sides straight, angle blunt; the dark markings are of the same type as in *Athysanus Sahlbergi*, &c., but are rarely developed, although their position is generally indicated by sundry pale brown spots or lines. Frons pale brown, with the apex, a linear middle stripe, and the side-lines yellow. Pronotum about one-third longer than the crown. Elytra more or less strongly tinged with fuscous at the apex; nerves yellow. Abdomen black, connexivum and the apex beneath yellow. Legs yellow, with black points; under side of thighs sometimes with a black line indicating the commencement of a band on the apical third. Length, 6½—7 mm.

On various trees in woods; common. A variety of this species, which has the inner areas of the elytra more or less filled up with dark fuscous, is the *Thamnotettix stupidula*, Zett., and another, in which the head, pronotum, and scutellum are tinged with red, is the *T. tincta* of the same author. Judging from Kirschbaum's description (Cicad., 94, 23) his *T. Zelleri* is quite distinct from this species.

2. *Thamnotettix dilutior*, Kbm.

Thamnotettix dilutior, Kirschb., Cicad., 92, 20.
Athysanus dilutior, Scott, Ent. Mo. Mag., xii., 99, 11.

Crown, pronotum, and scutellum yellowish white, generally with indistinct rust-yellow markings. Crown (with the eyes) almost crescent-shaped, obtusely produced in front, less so in the female than in the male, its length down the middle about one-fourth longer than half its basal width, in the male one-third, in the female about one-half, longer in the middle than at the sides. Frons brownish yellow, with pale side-lines. Pronotum about one-third longer than the crown. Elytra greyish yellow, sometimes with a few isolated blackish spots or suture narrowly blackish, or a black spot in the apex of the clavus; nerves fine, whitish. Abdomen above in the male black, hind margins of the segments narrowly pale, genital valve semicircular; in the female yellow, sometimes with the base of the segments more or less widely black. Legs pale yellow, striped, spotted, and sometimes banded with black. Length, 6—6½ mm.

Not uncommon on oaks.

9. *Thamnotettix subfuscula*, Fall.

Cicada subfuscula, Fall., Hem. Suec., ii., 44, 31.
Thamnotettix subfuscula, Zett., Ins. Lapp., 294, 8; J. Sahl., Not. Fenn., xii., 218, 10.
Jassus subfusculus, H.-Scff., Deuts. Ins., 130, 4; Germ., Faun. Ins. Eur., xvi., 19; Flor, Rhyn. Liv., ii., 354, 21; Marsh., Ent. Mo. Mag., iii., 85, 25; Kirschb., Cicad., 93, 21; Thoms., Opusc. Ent., i., 49, 8.
J. pectoralis, Germ., Mag. d'Ent., iv., 91, 30; Burm., Handb., ii., 111. 3.
Athysanus subfusculus, Scott, Ent. Mo. Mag., xii., 99, 10; Reut., Medd. Faun. Flor. Fenn., v. (1880), 226, 38; Ferrari, Cicad. agri Ligust., 56, 15 and 58, 180.

Upper side yellow-brown, suture of elytra frequently blackish. Crown in the male as long as half its basal width, about one-third longer in the middle than at the sides; in the female about one-hird longer than half its basal width, nearly twice as long in the middle as at the sides; free sides nearly straight and angle blunt in both sexes; interocular line, when present, widened and interrupted in the middle; interocellar line widened, angular, and

interrupted in the middle; infraocellar line feeble, biarcuate. Frons black, a linear middle stripe dilated at the clypeus and the side-lines yellow. Pronotum about one-third longer than crown, with four or six black points in front, and some feeble traces of three or five whitish stripes on the hinder two-thirds. Scutellum generally with a dark triangle on each side of the base, and a pair of black points on the disc. Elytra in the male with the suture narrowly and the part adjoining the angular nerves blackish, apical areas fuscous; nerves, especially those near the suture, whitish; in the female uniform yellow-brown, with the nerves but little paler than the ground colour. Abdomen black; hind margin of the last dorsal segment reddish yellow-brown in the female; genital valve in the male triangular. Legs greyish yellow, striped, spotted, and banded with black. Length, 5—6 mm.

Common throughout the summer on various trees and bushes. I have taken males amongst low herbage in a bog in April in company with *Athysanus grisescens*, Zett. Specimens of the male occur in which the elytra, especially on each side of the nerves, are thickly speckled with fuscous, and the latter appear more decidedly pale in consequence.

4. *Thamnotettix variegata*, Kbm.

Athysanus variegatus, Kirschb., Athys. Art., 9, 8.
Thamnotettix variegata, Kirschb., Cicad., 112, 57; J. Sahl., Not. Fenn., xii., 211, 4.
Athysanus irroratus, Scott, Ent. Mo. Mag., xii., 96, 5.
A. variegatus, Reut., Medd. Faun. Flor. Fenn., v. (1880), 211, 212 and 218, 19; Ferrari, Cicad. agri Ligust., 57, 28 and 59, 133 (forte).

Crown (in the female) about one-fourth longer than half its basal width, one-third longer in the middle than at the sides, free sides very feebly arcuate, angle blunt; interocular line much dilated and interrupted in the middle, its hind margin angularly indented near each eye; interocellar line represented by four black points, of which the middle pair are occasionally wanting; infraocellar line biarcuate, abbreviated at each end, and interrupted in the middle, each half forming the upper margin of one of the two black patches on the frons. Frons yellow with black markings, which are reduced or obsolete between the antennæ and the apex. Pronotum greyish yellow, with a few black points in front, and four longitudinal series of short transverse fuscous lines on the

hinder two-thirds. Scutellum greyish yellow, with a triangle on each side of the base, a pair of points on the disc, a linear stripe on the basal half, and a pair of wide stripes on the apical half, black. Elytra greyish yellow, more or less closely speckled with black, the transverse nerve, the apices of the anal and axillary nerves, and the ramifications of the others, white. Abdomen above black, sides and apex yellow. Legs greyish yellow, banded, striped, and spotted with black. Length, 4 mm.

Widely distributed but not common, and probably overlooked. Exceptionally dark examples do not exhibit the white portions of the nerves so distinctly as specimens of average coloration. A dark male from Deal has the black stripe on the inner side of the hind tibiæ thickened above and below, so as to give that part somewhat the appearance one finds in *Pediopsis tibialis*, Scott.

5. *Thamnotettix plebeja*, Fall.

Cicada plebeja, Fall., Hem. Suec., ii., 36, 19.
Thamnotettix plebeja, Zett., Ins. Lap., 295, 12; J. Sahl., Not. Fenn., xii., 211, 3.
Jassus plebejus, H.-Scff., Deuts. Ins., 130, 7; Thoms., Opusc. Ent., i., 47, 4.
Athysanus plebejus, Flor, Rhyn. Liv., ii., 291, 10; Kirschb., Athys. Art., 8, 6; Cicad., 11, 54; Scott, Ent. Mo. Mag., xii., 98, 8; Ferrari, Cicad. agri Ligust., 57, 24 and 59, 132 (?).
A. Schenkii. Kirschb., Cicad., 111, 56; Reut., Medd. Faun. Flor. Fenn., v. (1880), 211, 213 and 218, 18.

Very nearly resembles the preceding in colour and markings, but is larger and wider, with the white portions of the nerves more decidedly milk-white, and the two uppermost of the black transverse side-lines on the frons, although stronger than the rest, never coalesce with the infraocellar line to form a pair of black patches, as in the last species. Crown in the male a little longer than half its basal width, about one-fourth longer in the middle than at the sides, in the female one-third longer than half its basal width, one-third longer in the middle than at the sides, free sides distinctly arcuate, angle blunt. Length, 5 mm.

This species occurred in profusion amongst long grass in a badly-kept garden at Norwich in July and August, but I have seen no other examples.

6. *Thamnotettix striatula*, Fall.

Cicada striatula, Fall., Hem. Suec., ii., 46, 33.
Thamnotettix striatula, Zett., Ins. Lap., 294, 10.
Jassus striatulus, H.-Scff., Deuts. Ins., 130, 8; Flor, Rhyn. Liv., ii., 361, 24; Marsh., Ent. Mo. Mag., iii., 84, 24; Kirschb., Cicad., 96, 26; Thoms., Opusc. Ent., i., 64, 43.
J. corniculus, Marsh, *l. c.*, 119.
Limotettix striatula, J. Sahl., Not. Fenn., xii., 253, 23.
Athysanus striatulus, Scott, Ent. Mo. Mag., xii., 100, 13; Reut., Medd. Faun. Flor. Fenn., v. (1880), 208, 203 and 215, 12; Ferrari, Cicad. agri Ligust., 56, 16.

Upper side greyish yellow, with strong black markings; all the areas of elytra margined with black. Crown (in the female) about one-fourth longer than half its basal width, one-third longer in the middle than at the sides, free sides nearly straight, angle blunt; basal markings represented by a black transverse line, which touches the interocular line in three equidistant points; interocular line complete; interocellar line represented by a pair of short curved lines running parallel with the biarcuate infraocellar line, the latter interrupted in the middle. Frons black, with the apex, a fine middle stripe, and the side-lines, pale. Pronotum about one-third longer than the crown, greyish yellow mottled with black. Scutellum greyish yellow, with distinct black markings. Elytra greyish yellow, all the areas margined with black, and the first subapical area filled up with the same colour; nerves concolorous, the two transverse ones widened. Breast and abdomen black, the latter with the hind margins of the segments narrowly pale. Legs brownish yellow, striped, spotted, and more or less widely banded with black. Length, 2¾—4 mm.

Apparently scarce. Said to occur amongst *Trifolium arvense*. Marshall took it rather commonly at Rannoch in July, 1866, on *Pteris*, in open places where the heather had been burned.

7. *Thamnotettix cruentata*, Panz.

Cicada cruentata, Panz., Deuts. Ins., 61, 15; Fall., Hem. Suec., ii., 41, 27.
Jassus cruentatus, Flor, Rhyn. Liv., iii., 330, 7; Marsh., Ent Mo. Mag., iii., 84, 23; Kirschb., Cicad., 96, 27: Thoms., Opusc. Ent., i., 50, 11.

Thamnottetix cruentata, Zett., Ins. Lap., 293, 5; J. Sahl., Not. Fenn., xii., 220, 12; Scott, Ent. Mo. Mag., xii., 22, 3; Ferrari, Cicad. agri Ligust., 50, 3; Fieb., Cicad. d'Eur. (*Thamnotettix*), 84, 19.

Upper side pale greyish yellow, finely and more or less closely speckled with blood-red. Forehead in the male with a pair of roundish black spots, and these are sometimes indicated in the female. Abdomen above black, narrowly pale at the sides. Legs pale; inner edge of hind tibiæ generally narrowly black. Length, 5—6 mm.

Widely distributed, but local.

8. *Thamnotettix Torneella*, Zett.

Thamnotettix Torneella, Zett., Ins. Lap., 294, 7; J. Sahl., Not. Fenn., xii., 221, 13; Fieb., Cicad. d'Eur. (*Thamnotettix*), 76, 14.
T. punctifrons, Scott, Ent. Mo. Mag., xii., 24, 7.
Jassus Torneellus, Flor, Rhyn. Liv., ii., 350, 18; Thoms., Opusc. Ent., i., 50, 10.
J. punctifrons, Marsh., Ent. Mo. Mag., iii., 31, 19.

Crown sublunate, a little longer than half its basal width, yellowish white, with a black or brown transverse band. Frons yellowish white; forehead with two round black spots. Pronotum yellowish white, about one-half longer than the crown, narrowly black in front, greyish behind. Elytra pale brown, with fine yellowish white nerves, the costa widely and the membrane hyaline, the latter smoky at the apex. Breast and abdomen black, sides of the the latter and the margins of the segments narrowly yellow. Legs yellowish white; hind tibiæ with a black stripe on the inner side. Length, 4½—5 mm.

Marshall found this species common in Epping Forest, frequenting apparently several different kinds of trees, but the only recent specimens that I have seen were taken by the late George Norman, by beating heather on a dry bank at Forres in the spring.

9. *Thamnotettix splendidula*, Fab.

Cicada splendidula, Fab., Sys. Rhyn., 79, 83; Fall., Hem. Suec., ii., 43, 30.
Jassus splendidulus, Flor, Rhyn. Liv., ii., 356, 23; Marsh., Ent. Mo. Mag., iii., 82, 20; Kirschb., Cicad., 98, 31; Thoms., Opusc. Ent., i., 49, 9.

Thamnotettix splendidula, J. Sahl., Not. Fenn., xii., 219, 11; Scott, Ent. Mo. Mag., xii., 28, 6; Fieb., Cicad. d'Eur. (*Thamnotettix*), 75, 13.

Crown and forehead yellow, each with two subquadrate black spots. Frons yellow with black side-lines. Pronotum greyish yellow, with a few black points in front and sometimes four abbreviated fuscous stripes on the hinder two-thirds. Scutellum yellow, a triangle on each side of the base and a pair of points on the disc black. Elytra pale brownish yellow, the first apical area, a more or less distinct spot at the base and apex of the third and fourth subapical areas, a spot at the apex of the brachial area, and the suture narrowly, blackish brown; the transverse nerve, the apices of the anal and axillary nerves, and the ramifications of the others distinctly whitish. Abdomen above black; hind margin of the last dorsal segment in the female yellow. Legs greyish yellow; inner edge of hind tibiæ narrowly black. Length, 5 mm.

Not uncommon on various trees and bushes. Specimens occasionally occur in which all the areas of the elytra are more or less filled up with blackish brown.

10. *Thamnotettix crocea*, H.-S.

Jassus croceus, H.-Scff., Deuts. Ins., 144, 7.
J. attenuatus, Marsh., Ent. Mo. Mag., iii., 29, 16.
Deltocephalus oxypterus, Kirschb., Cicad., 130, 91.
Thamnotettix crocea, Scott, Ent. Mo. Mag., xii., 22, 1; Ferrari, Cicad. agri Ligust., 50, 6 and 54, 123; Fieb., Cicad. d'Eur. (*Thamnotettix*), 72, 11.

Crown and pronotum rust-yellow, the former with four, the latter with five white stripes; interocellar line represented by an oblique black line on each side of the apex of the crown. Scutellum rust-yellow, with three white stripes. Elytra pale brownish yellow, second apical area filled up with dark fuscous, and sometimes the third subapical, the subcostal area, and the suture are narrowly bordered with fuscous; nerves whitish, that of the suture conspicuously white. Abdomen above black, sides narrowly yellow; genital plates in the male narrowly rounded at the apex; hind margin of the last ventral segment in the female nearly straight. Legs pale greyish yellow, a point at the apex of the hind thighs on the inner side and the inner side of the hind tibiæ narrowly black. Length, 4¼—5½ mm.

Very common amongst grasses.

11. *Thamnotettix attenuata*, Germ.

Jassus attenuatus, Germ., Mag. d'Ent., iv., 91, 31.
J. rupicapra, Marsh., Ent. Mo. Mag., iii., 30, 17.
Deltocephalus croceus, Kirschb., Cicad., 131, 92.
Thamnotettix attenuata, Scott, Ent. Mo. Mag., xii., 22, 2; Ferrari, Cicad. agri Ligust., 50, 7; Fieb., Cicad. d'Eur. (*Thamnotettix*), 73, 12.

Very similar in appearance to the preceding species, but smaller, with the white stripes on the crown, pronotum, and scutellum less distinct, the elytra less pointed, bearing on the disc a few irregular blackish spots, and a very constant small blackish spot on the middle of the suture of each. Genital plates subtruncate at the apex; hind margin of the last ventral segment in the female strongly concave. Length, 4 mm.

Amongst fine grasses in dry places; not generally common.

vi. Limotettix, *J. Sahl.* (Pl. III., fig. 14).

J. Sahlberg, Not. Fenn., xii., 224, 25 (1871).

Body elongate or oblong, generally much narrowed behind. Head obtuse in front; crown sublunate or more or less produced; frons nearly straight-sided, its width between the antennæ equal to or somewhat greater than the width of one of the cheeks. Sides of the pronotum very short, subterete. Elytra ample, longer than the abdomen, overlapping at the apex; appendix well-developed.

Table of Species.

1 (12). Elytra with four subapical areas.
2 (3). Crown with a black band .. .. .. 1. *striola.*
3 (2). Crown not banded with black.
4 (11). Forehead with black spots.
5 (6). ♂ brownish yellow, face and legs strongly tinged with red; ♀ greyish yellow .. 2. *antennata.*
6 (5). Species yellow or greenish yellow, sometimes with black stripes on the elytra.
7 (8). Spots on the forehead sublunate .. .. 3. *intermedia.*
8 (7). Spots on the forehead roundish.
9 (10). Elytra pellucid, with yellow nerves, rarely with ill-defined fuscous stripes in the clavus .. .. 4. *quadrinotata.*
10 (9). Elytra yellow, with distinct black stripes, which in the male occupy almost the entire surface .. .. 5. *nigricornis.*

11 (4). Forehead without black spots .. .. 6. *sulphurella.*
12 (1). Elytra with three subapical areas.
13 (14). Outer cubital nerve distinct, at least on its basal half .. .. 7. *metrius.*
14 (13). Outer cubital nerve obsolete or wanting.
15 (18) Frons without black transverse lines.
16 (17). Frons with a black spot just above the clypeus .. .. 8. *septemnotata.*
17 (16). Frons without a black spot at the apex .. 9. *variata.*
18 (15). Frons with black transverse lines .. .. 10. *sexnotata.*

1. *Limotettix striola*, Fall.

Cicada striola, Fall., Act. Holm., 1806, 31, 28; Hem. Suec., ii., 44, 32.
Jassus striola, H.-Scff., Deuts. Ins., 124, 4, *e* and *f*; Flor, Rhyn. Liv., ii., 315, 1; Marsh., Ent. Mo. Mag., iii., 126, 30; Kirschb., Cicad., 87, 11; Thoms., Opusc. Ent., i., 63, 40.
J. frenatus, Germ., Mag. d'Ent., iv., 86, 16.
Limotettix striola, J. Sahl., Not. Fenn., xii., 226, 1.
Athysanus striola, Scott, Ent. Mo. Mag., xii., 168, 14; Ferrari, Cicad. agri Ligust., 55, 9 and 58, 127.

Upper side dirty greyish or greenish yellow. Crown sublunate, a little produced in front in the female; interocular line broad, complete; infraocellar line biarcuate, sometimes confluent with the interocular line in the male. Frons in the male black, with the apex narrowly, a fine middle stripe, and the side-lines, yellow; in the female yellow, with a fine double middle stripe and the side-lines black. Pronotum about one-fourth (♂) or one-third (♀) longer than the crown, sometimes sparingly speckled with black. Elytra greyish yellow, pellucid; nerves whitish or yellow, sometimes margined with fuscous; claval suture frequently narrowly black. Breast and abdomen black, the sides and margins of the segments narrowly yellow; hind margin of last ventral segment in the female strongly concave. Legs yellow, spotted, striped, and banded with black. Length, 3½—4½ mm.

Locally common in damp places.

2. *Limotettix antennata*, Boh.

Thamnotettix antennata, Boh., Sv. Ak. Handl., 1845, 35, 11.
T. frontalis, Scott, Ent. Mo. Mag., xii., 25, 12; Fieb., Cicad. d'Eur. (*Thamnotettix*), 86, 21.

Jassus antennatus, Marsh., Ent. Mo. Mag., iii., 30, 18; Thoms., Opusc. Ent., i., 59, 29.
J. longicornis, Kirschb, Cicad., 95, 30.
Limotettix antennata, J. Sahl., Not. Fenn., xii., 238, 10.

♂. Brownish yellow; face and legs strongly tinged with red: ♀ greyish yellowish; generally a spot on each temple, and a pair of larger roundish or oblong ones on the forehead and the frontal sutures, black; occasionally there is a punctiform black spot behind each ocellus. Antennæ nearly as long as the body. Crown about one-third longer than half its basal width, one-third or (in the female) more than one-third longer in the middle than at the sides, free sides gently arcuate, angle pointed. Pronotum subequal in length to the crown. Elytra subhyaline, nerves pale. Breast black, sides widely pale; abdomen above black, sides narrowly pale, beneath black, connexivum yellow; last ventral segment in the female roundly produced behind, at least one-half longer than the preceding segment. Hind tibiæ with some points on the outer side and a narrow stripe on the inner side black. Length, 5½—6 mm.

Common in marshes. A dark form of the male occurs rarely in which the areas of the elytra, especially those near the suture, are more or less filled up with fuscous. *Jassus antennatus*, Flor (*L. Flori*, J. Sahl), is greenish yellow, with the last ventral segment of the female subequal in length to the preceding segment.

3. *Limotettix intermedia*, Boh.

Thamnotettix intermedia, Boh., Sv. Ak. Handl., 1845, 40, 15; Scott. Ent. Mo. Mag., xii., 25, 10; Fieb., Cicad. d'Eur. (*Thamnotettix*), 88, 23.
Jassus intermedius, Thoms., Opusc. Ent., i., 60, 31.
Limotettix intermedia, J. Sahl., Not. Fenn., xii., 235, 8.
L. lunulifrons, J. Sahl., *l. c.*, 236, 9.

Yellow or greenish yellow, a point behind each ocellus, and sometimes a pair (which are frequently confluent) between them, a transverse spot on each temple, a pair of sublunate spots on the forehead, a spot at the base of each antenna, a few transverse side-lines on the frons, and the facial sutures, black. Crown in the male subequal in length to half its basal width, about one-half longer in the middle than at the sides, free sides nearly straight, angle blunt. Pronotum scarcely one-fourth longer than the crown. Elytra flavo-hyaline, nerves yellow. Breast black, sides

of the pro- and mesosternum yellow. Abdomen black, its sides and the margins of the segments narrowly yellow. Legs yellow, with black stripes and points. Length, 5 mm.

Loch Greenin, September, 1866 (*Douglas*).

4. *Limotettix quadrinotata*, Fab.

Cicada 4-notata, Fab., Sys. Rhyn., 78, 77; Fall., Hem. Suec., ii., 46, 35.
Jassus 4-notatus, H.-Scff., Deuts. Ins., 122, 4 c; Flor, Rhyn. Liv., ii., 336, 11; Marsh., Ent. Mo. Mag., iii., 104, 28; Kirschb., Cicad., 102, 38; Thoms., Opusc. Ent., i., 61, 35.
J. strigipes, Thoms., *l. c.*, 62, 36.
Cicadula 4-notata, Zett., Ins. Lap., 296, 1.
C. strigipes, Zett., *l. c.*, 296, 2.
Aphrodes spilotocephala, Hardy, Trans. Tynes. F. C., i., 424, 1.
Limotettix 4-notata, J. Sahl., Not. Fenn., xii., 229, 4.
Thamnotettix 4-notata, Scott, Ent. Mo. Mag., vii., 25, 14; Fieb., Cicad. d'Eur. (*Thamnotettix*), 90, 26.
T. strigipes, Fieb., *l. c.*, 64, 5.

Yellow or greenish yellow, a large roundish spot behind each ocellus, two others on the forehead, a spot at the base of the antennæ, the facial sutures, and occasionally some traces of side-lines on the frons, black. Crown subequal in length to half its basal width, about one-half longer in the middle than at the sides, free sides arcuate, angle rounded. Pronotum about one-fourth longer than the crown. Scutellum sometimes with black markings. Elytra pellucid, frequently fumose on the apical third; nerves yellow, sometimes becoming fuscous at the apex. Breast black, sides of pro- and mesosternum narrowly yellow. Abdomen black, its sides and the margins of the segments very narrowly yellow. Legs striped and spotted with black. Length, 4—4¾ mm.

Very common amongst grasses. A form with the dark markings exaggerated and some fuscous stripes in the clavus occurs somewhat rarely, and is the *Cicadula strigipes*, Zett., Fieb.

5. *Limotettix nigricornis*, J. Sahl.

Limotettix nigricornis, J. Sahl., Not. Fenn., xii., 232, 6.
Thamnotettix nigricornis, Scott, Ent. Mo. Mag., xii., 91.

Closely allied to the last species, but about one-half larger, and

also distinguished by the black stripes on the elytra; the latter in the male occupy almost the entire surface, but in the female they are confined to the clavus or entirely wanting; apical areas blackish. Length, 5—5½ mm.

Not common. Colton, Somersetshire (*Power*); it has also been taken by Blatch.

6. *Limotettix sulphurella*, Zett.

Cicadula sulphurella, Zett., Ins. Lap., 297, 8.
Cicada virescens, Fall., Hem. Suec., ii., 52, 45.
Jassus virescens, Flor, Rhyn. Liv., ii., 339, 9; Marsh., Ent. Mo. Mag., iii., 103, 27; Kirschb., Cicad., 101, 37; Thoms., Opusc. Ent., i., 61, 34.
Limotettix sulphurella, J. Sahl., Not. Fenn., xii., 239, 12.
Thamnotettix virescens, Scott, Ent. Mo. Mag., xii., 25, 13; Fieb., Cicad. d'Eur. (*Thamnotettix*), 95, 30.
T. sulphurella, Ferrari, Cicad. agri Ligust., 51, 13.

Sulphur-yellow, at the base of each antenna a black spot. Crown subequal in length to half its basal width, about one-third longer in the middle than at the sides, free sides gently arcuate, angle blunt. Frons sometimes with traces of fuscous side-lines. Pronotum nearly twice as long as the crown. Elytra flavo-hyaline, nerves yellow. Middle of the breast black. Abdomen above in the male black, sides narrowly yellow; in the female yellow, broadly black down the middle; under side black at the base in both sexes. Outer side of hind tibiæ with some black points. Length, 4—5 mm.

Common amongst grasses.

7. *Limotettix metrius*, Flor.

Jassus metrius, Flor, Rhyn. Liv., ii., 264, 16; Kirschb., Cicad., 137, 107.
Deltocephalus metrius, Fieb., Syn. Eur. Delto., 20, 58, fig. 58; J. Sahl., Not. Fenn., xii., 326, 19; Scott, Ent. Mo. Mag., xii., 241, 3.

♂. Fore parts deep yellow; elytra pale greyish yellow. ♀ dirty yellowish white; the areas towards the apex of the elytra sometimes faintly margined with fuscous; suture occasionally blackish. Crown nearly twice as long as half its basal width, one-half longer in the middle than at the sides, free sides distinctly arcuate, angle blunt. Pronotum subequal in length to the crown. Nerves of the elytra yellow in the male, whitish in the female. Abdomen above

more or less widely black, beneath marked with black on the sides and in the middle of the base; hind margin of the last ventral segment in the female with a small rounded lobe in the middle, bounded on each side by a notch; opposite to each notch a comma-shaped black spot. Legs pale; hind tibiæ with conspicuous black points on the outer side. Length, 3½—4 mm.

Amongst long herbage in marshes; not uncommon in East Norfolk. This species may be readily distinguished by the neuration of the elytra; in the structure of the male genitalia it is a true *Limotettix*, although the crown is somewhat Deltocephaloid.

8. *Limotettix septemnotata*, Fall.

Cicada 7-notata, Fall., Act. Holm., 1806, 35, 35; Hem. Suec., ii., 49, 38.
Cicadula 7-notata, Zett., Ins. Lap., 297, 6; Scott, Ent. Mo. Mag., xi., 231, 4; Fieb., Cicad. d'Eur. (*Cicadula*), 52, 10.
Jassus 7-notatus, Flor, Rhyn. Liv., ii., 339, 12; Marsh., Ent. Mo. Mag., iii., 126, 31; Kirschb., Cicad., 100, 24; Thoms., Opusc. Ent. i., 76, 69.
Limotettix 7-notata, J. Sahl., Not. Fenn., xii., 251, 21.

Head, pronotum, and scutellum yellow, a large spot in each basal angle of the latter, a pair of points on the base of the crown, two large roundish spots on the forehead, a spot at the base of each antenna, and another just above the clypeus, black. Crown subequal in length to its basal width, about one-half longer in the middle than at the sides, free sides gently arcuate, angle obtusely rounded. Clavus and corium whitish hyaline, each with a broad yellow stripe, reach about two-thirds of its length; inner margin of elytra very narrowly blackish; membrane smoky. Abdomen yellow, with a wide black stripe down the back; saw-case black. Legs yellow; hind tibiæ with a few black points. Length, 3½ mm.

Not uncommon in marshes. The subantennal spots and the points at the base of the crown are frequently wanting, and a variety of the female occurs in which the pronotum is strongly marked with black, and the claval suture, the brachial nerve, and a narrow stripe just below the costa are blackish.

9. *Limotettix variata*, Fall.

Cicada variata, Fall., Act. Holm., 1806, 34, 34; Hem. Suec., ii., 48, 37.
Jassus fumatus, H.-Scff., Deuts. Ins., 153, 5.
J. variatus, Marsh., Ent. Mo. Mag., iii., 127, 32; Kirschb., Cicad., 99, 32; Thoms., Opusc. Ent., i., 76, 70.
J. sexnotatus, var., Flor, Rhyn. Liv., ii., 341.
Limotettix variata, J. Sahl., Not. Fenn., xii., 250, 20.
Cicadula variata, Scott, Ent. Mo. Mag., xi., 231, 3; Fieb., Cicad. d'Eur. (*Cicadula*), 51, 9.

Head, pronotum, and scutellum yellow, a roundish spot in each basal angle of the latter, a pair of roundish spots on the base of the crown, another pair on the forehead, and the frontal sutures narrowly, black. Crown about one-fourth shorter than its basal width, one-half longer in the middle than at the sides, free sides feebly arcuate, angle blunt. Pronotum about one-fourth longer than the crown. Elytra whitish hyaline, tinged with yellow, within with a broad irregular curved fuscous stripe, which commences at the base and ends at the apex of the clavus, and is produced in the middle of its outer edge about half-way across the corium; second and third subapical areas with a fuscous streak in each. Abdomen above black, sides yellow, beneath yellow, black at the base. Legs yellow; hind tibiæ with a few black points. Length, 4 mm.

Scarce; said to occur on oaks.

10. *Limotettix sexnotata*, Fall.

Cicada 6-notata, Fall., Act. Holm., 1806, 34, 33; Hem. Suec., ii., 47, 36.
Cicadula 6-notata, Zett., Ins. Lap., 297, 4; Scott, Ent. Mo. Mag., xi., 230, 1; Ferrari, Cicad. agri Ligust., 46, 3; Fieb., Cicad. d'Eur. (*Cicadula*), 47, 6.
C. alpina, Zett., *l. c.*, 297, 5.
C. frontalis, Scott, *l. c.*, 231 (sec. spec. typ.).
Tettigonia 6-notata, Germ., Faun. Ins. Eur., xiv., t. 13.
Eupteryx 6-notatus, Curt., Brit. Ent., 640, 10.
Jassus 6-notatus, H.-Scff., Deuts. Ins., 122, 4 and 164, 6; Flor, Rhyn. Liv., ii., 341, 13; Marsh., Ent. Mo. Mag., iii., 125, 29; Kirschb., Cicad., 95, 25; Thoms., Opusc. Ent., i., 77, 71.
Limotettix 6-notata, J. Sahl., Not. Fenn., xii., 247, 19.

Head yellow, basal markings roundish; interocular line widely interrupted in the middle; on the forehead a pair of large roundish subquadrate or oblong black spots; frons with black side-lines. Pronotum yellow, sometimes suffused with blackish. Scutellum yellow, sometimes with a subtriangular black spot on each side of the base. Elytra yellowish grey, subpellucid without markings, or subcoriaceous with a greater or lesser number of the areas each occupied by a fuscous streak; membrane sometimes smoky. Abdomen black, yellow at the apex beneath. Legs yellow, with black lines and points. Length, 2¾—5 mm.

Excessively abundant amongst grasses. Very variable in size and markings, and also in the dimensions of the crown; the markings on the latter are subject to almost any amount of exaggeration, reduction, or suppression. J. Sahlberg nearly exhausts the alphabet in furnishing distinctive letters for the varieties which he characterises.

vii. Gnathodus, *Fieb.* (Pl. III., fig. 18).

Fieb., Neue Gatt. und Art. Hom., 9, 21 (1866).

Body oblong, obtuse in front, much narrowed behind. Crown very short, about one-fourth as long as the pronotum, scarcely longer in the middle than at the sides. Elytra much longer than the abdomen, overlapping at the apex; outer branch of the cubital nerve obsolete; membrane very large, as long as the inner margin of the clavus; appendix large. Submarginal wing-nerve complete; upper branch of the second wing-nerve confluent with the first, and running into the submarginal nerve as one nerve; third wing-nerve joined to the lower branch of the second by a transverse nerve.

1. *Gnathodus punctatus*, Thunb.

Cicada punctata, Thunb., Act. Ups., vi., 21, 36; Fall., Hem. Suec., ii., 55, 52.
Eupteryx clypeata, Curt., Brit. Ent., 640, 12.
Cicadula punctata, Zett., Ins. Lap., 298, 10.
C. spreta, Zett., *l. c.*, 298, 11.
Jassus punctatus, H.-Scff., Deuts. Ins., 122, 6; Flor, Rhyn. Liv., ii., 320, 3; Marsh., Ent. Mo. Mag., iii., 127, 33; Kirschb., Cicad., 90, 16; Thoms., Opusc. Ent., i., 77, 72.
Gnathodus punctatus, J. Sahl., Not. Fenn., xii., 204, 1; Ferrari, Cicad. agri Ligust., 44, 1 and 45, 107.

♂. Greyish yellow or pale salmon-coloured; elytra with a few black spots arranged in two oblique bands, one on the basal third, the other next the angular nerves; ♀, pale green, the spots on the elytra reduced to two on the clavus, one at the apex, the other near the base, and one or two on the corium next the angular nerves. Crown obtusely produced in front. Head, pronotum, and scutellum sometimes marked with fuscous or black; in the apex of each wing a fuscous streak. Abdomen black, hind margins of the segments narrowly pale. Legs pale; tibiæ sometimes dark towards the apex, and with dark points on the outer side. Length, 3½—4 mm.

By sweeping in summer, and beating firs in winter and spring; not very common.

XV. TYPHLOCYBIDÆ.

Small, elongate species, for the most part brightly coloured. Ocelli not or scarcely perceptible, sometimes indicated on the forehead. Face very long, triangular. Elytra much longer than the abdomen, overlapping at the apex; appendix wanting (except in *Alebra*). Corium with three simple longitudinal nerves only. The latter character distinguishes this group from all others. The genera are readily separable by the characters derived from the neuration of the elytra and wings.

Table of Genera.

1 (2).	Membrane with an appendix	i. Alebra.
2 (1).	Membrane without an appendix.	
3 (8).	Submarginal wing-nerve continued round the apex of the wing.	
4 (5).	Third wing-nerve forked	ii. Dicraneura.
5 (4).	Third wing-nerve simple.	
6 (7).	Second apical area triangular	iii. Kybos.
7 (6).	Second apical area oblong	iv. Chlorita.
8 (3).	Submarginal wing-nerve running out to the margin before the apex of the wing.	
9 (10).	First two wing-nerves subparallel throughout	v. Eupteryx.
10 (9).	First two wing-nerves confluent near the apex.	
11 (12).	First apical area ample, third irregular in figure	vi. Typhlocyba.
12 (11).	First apical area very small, third oblong	vii. Zygina.

i. Alebra, *Fieb.* (Pl. III., fig. 16).

Fieb., Cicad. d'Eur., pt. i., 125 (1876).

Body linear. Front and hind margins of the crown parallel, feebly curved. Ocelli distinct. Pronotum distinctly wider than the head with the eyes. Elytra much longer than the abdomen, overlapping at the apex, with a distinct appendage, the three inner apical areas oblong, truncate at the base. Submarginal wing-nerve running into the first nerve; in the apex of the wing three oblong areas. Genital valve wanting in the male.

1. *Alebra albostriella*, Fall.

Cicada albostriella, Fall., Hem. Suec., ii., 54, 49.
C. elegantula, Zett., Faun. Ins. Lap., 536, 35.
Typhlocyba albostriella, H.-Scff., Deuts. Ins., 164, 11; Flor, Rhyn. Liv., ii., 382, 1; Kirschb., Cicad., 177, 1.
T. elegantula, id., *l. c.*, 124, 23.
T. discicollis, id., *l. c.*, 124, 8.
T. fulveola, id., *l. c.*, 165, 16.
T. Wahlbergi, Boh., Sv. Ak. Handl., 42, 17 (1847).
T. eximia, Hardy, Trans. Tynes. F. C., i., 417, 2.
Cicadula elegantula, Zett., Ins. Lap., 298, 12.
Eupteryx fasciata, Curt, Brit. Ent., 640, 3.
E. albostriellus, Marsh, Ent. Mo. Mag., iii., 218, 1.
Compsus albostriella, J. Sahl., Not. Fenn., xii., 156, 1.
Alebra albostriella, Leth., Cat. Hem. Nord., ed. ii., 64 and 77; Ferrari, Cicad. agri Ligust., 74 and 75; Fieb., Cicad. d'Eur. (*Typhlocybini*), 1.

This handsome insect presents the following well-marked colour varieties:—

♂. Fore parts and legs yellow or red-yellow; elytra yellow or greenish yellow; apices of the areas of the corium and the membrane fumose.

♀. *a.* Upper side, face and legs white, the two latter sometimes tinged with yellow; two broad stripes on the pronotum, the suture of the elytra broadly, a stripe in the brachial area, and a broad one along the costa, yellow; apices of the areas of the corium and the membrane faintly fumose. The stripes on the pronotum and the suture of the elytra are frequently red.

b. Upper side, face and legs white, the two latter sometimes tinged with yellow; hind part of the crown, the pronotum (except

at the sides), and the scutellum, dark brown; elytra with a stripe along the suture, one in the brachial area, and another along the costa, yellow; on the inner margin just behind the middle a large ill-defined dark brown spot.—Length, 2¾ – 3½ mm.

By beating various trees and bushes; common.

ii. DICRANEURA, *Hardy*. (Pl. III., fig. 19).

Hardy, Trans. Tynes. F. C., i., 428, 1850 (*Dikraneura*).

Body small, linear. Head obtusely produced in front. Elytra much longer than the abdomen; nerves of the membrane sub-parallel; appendix wanting. Submarginal wing-nerve complete; first and second wing-nerves confluent before the apex, and running into the submarginal nerve as one nerve; third wing-nerve forked and joined to the second by a transverse nerve.

This genus is equivalent to *Notus* and *Erythria*, Fieb. All the species live amongst grasses and other low plants.

TABLE OF SPECIES.

1 (8). Wing-nerves pale.
2 (3). Front of crown angular (more conspicuously in the ♀) .. . . 1. *flavipennis*.
3 (2). Front of crown not angular.
4 (7). Genital plates subcylindrical, curved, approaching at the base and apex.
5 (6). Genital plates wide and stout, their apices (viewed from the side) truncate, bounded on each side by an erect blackish tooth .. 2. *citrinella*.
6 (5). Genital plates long, slender, their apices pointed; on the inner margin just below the apex a strong triangular tooth .. .. 3. *similis*.
7 (4). Genital plates elongate-triangular, flat, their inner margins subcontiguous. Penis black, resembling the claw-joint of a *Carabus*. Lobes of pygofer in the male each with a large blackish horn on the inner side near the apex .. .. 4. *mollicula*.
8 (1). Principal wing-nerves fuscous or black.
9 (10). Scutellum with a distinct black spot at the apex .. .. 5. *pygmæa*.
10 (9). Scutellum immaculate.
11 (12). Elytra membranous, more than three times as long as wide; suprabrachial area and the apical half of the subcostal area hyaline .. 6. *variata*.
12 (11). Elytra subcoriaceous, about 2½ times as long as wide, opaque throughout .. .. 7. *aureola*.

1. *Dicraneura flavipennis*, Zett.

Cicada flavipennis, Zett., Ins. Lap., 292, 15.
Typhlocyba flavipennis, Flor, Rhyn. Liv., ii., 388, 4; Kirschb., Cicad., 180, 8.
Eupteryx flavipennis, Marsh., Ent. Mo. Mag., iii., 219, 3.
Notus flavipennis, J. Sahl., Not. Fenn., xii., 163, 1; Leth., Cat. Hem. Nord., ed. ii., 64, 68 and 78; Ferrari, Cicad. agri Ligust., 76 and 77; Fieb., Cicad. d'Eur. (*Typhlocybini*), 12, 5.

Deep yellow; abdomen above black. Hind margin of pronotum with an arcuate notch of equal width with the base of the scutellum. Elytra deep yellow; membrane whitish hyaline. Hind tibiæ with a row of distinct black points. Length, 3¾ mm.

Common amongst *Carices*. This species is readily distinguished by its Deltocephaloid crown and the uniform distribution of the yellow pigment in the elytra.

2. *Dicraneura citrinella*, Zett.

Cicada citrinella, Zett., Faun. Ins. Lap., 536, 36.
Cicadula citrinella, Zett., Ins. Lap., 299, 13.
Typhlocyba citrinella, H.-Scff., Deuts. Ins., 124, 2.
T. forcipata, Flor, Rhyn. Liv., ii., 389, 5; Kirschb., Cicad., 181, 9.
T. gracilis, Zett., Ins. Lap., 299, 14.
Notus citrinellus, J. Sahl., Not. Fenn., xii., 165, 3; Ferrari, Cicad. agri Ligust., 76 and 77.
N. Schmidti, Leth., Cat. Hem. Nord., ed. ii., 65, 69 and 80; Ferrari, *l. c.*; Fieb., Cicad. d'Eur. (*Typhlocybini*), 15, 8.

Dirty yellow; abdomen above black, paler towards the apex. Corium dirty yellow, the apical half of the subcostal area, the suprabrachial area, and the apical third of the brachial area, hyaline. Membrane fusco-hyaline. Hind tibiæ with a row of distinct black points. Length, 3¼ mm.

Foxley Wood, Norfolk.

3. *Dicraneura similis*, Edw.

Dicranoneura similis, Edw., Ent. Mo. Mag., xxi., 229.

Very similar in size and colour to the last, from which it is best distinguished by the structure of the male genitalia. I cannot lay

down any characters by which to separate the females of the two species. Length, 3½ mm.

By sweeping grasses on wet commons in Norfolk; not unfrequent. In the original description (*l. c.*) I credit this species with *flat* genital plates: this mistake I attribute to insufficient examination of the only specimen then at hand before mounting for the microscope: the genital plates in this species agree with those of *D. citrinella* in their pincer-like formation (Pl. III., fig. 17).

4. *Dicraneura mollicula*, Boh.

Typhlocyba mollicula, Boh., Sv. Ak. Handl., 43, 18 (1847).
T. facialis, Flor, Rhyn. Liv., ii., 385, 2.
T. Flori, Kirschb., Cicad., 179, 6.
Notus molliculus, J. Sahl., Not. Fenn., xii., 166, 4; Ferrari, Cicad. agri Ligust., 76 and 77; Fieb., Cicad. d'Eur. (*Typhlocybini*), 13, 6.
N. facialis, Leth., Cat. Hem. Nord., ed. ii., 65, 69 and 79.
Dicranoneura mollicula, Dougl., Ent. Mo. Mag., xii., 28, 3.
D. citrinella, id., *l. c.*

Yellow, in some examples inclining to orange; abdomen above generally black towards the base. Hind margin of pronotum at most faintly concave. Elytra yellow, the membrane and a spot in the apex of the subcostal and suprabrachial areas hyaline. Length, 3¼ mm.

Very common amongst low plants in a variety of situations.

5. *Dicraneura pygmæa*, Dougl.

Dicranoneura pygmæa, Dougl., Ent. Mo. Mag., xii., 203.

♂. Orange-yellow; abdomen above black, genitalia yellow. Corium and clavus inwardly paler orange than on their outer sides, nerves deeper orange, inner margin of the clavus with a fuscous line. Membrane with a slightly fuscous tinge; nerves pale orange. Legs pale orange; claws infuscated. Length, 2¼ mm.

Darenth Wood, October (*Douglas*). The single male on which this species was founded still remains unique.

6. *Dicraneura variata*, Hardy.

Dikraneura variata, Hardy, Trans. Tynes. F. C., i., 423, 1.
Typhlocyba citrinella, Flor, Rhyn. Liv., ii., 386, 3; Kirschb., Cicad., 180, 7.
Eupteryx citrinellus, Marsh., Ent. Mo. Mag., iii., 218, 2.
Notus aridellus, J. Sahl., Not. Fenn., xii., 167, 5.
N. cephalotes, Leth., Cat. Hem. Nord., ed. ii.. 64, 68 and 78; Fieb., Cicad. d'Eur. (*Typhlocybini*), 9, 2.

Pale greenish yellow, dull; abdomen black. The colour of the elytra varies to dark green, sometimes with a reddish tinge, or occasionally deep orange-red, the latter in northern examples. Length, 3½ mm.

Locally common amongst low plants in damp places.

7. *Dicraneura aureola*, Fall.

Cicada aureola, Fall., Hem. Suec., ii., 39, 22.
Jassus aureolus, Germ., Faun. Ins. Eur., xvii., 20.
Typhlocyba aureola, H.-Scff., Deuts. Ins., 164, 16; Flor, Rhyn. Liv., ii., 391, 6; Kirschb., Cicad., 182, 11.
T. chlorophana, H.-Scff., *l. c.*, 124, 9.
Erythria aureola, J. Sahl., Not. Fenn., xii., 202, 1; Fieb., Cicad. d'Eur. (*Typhlocybini*), 6, 3.
Notus aureolus, Leth., Cat. Hem. Nord., ed. ii., 64, 68 and 78; Ferrari, Cicad. agri Ligust., 75.

Short and stout. Crown, pronotum, and scutellum yellow; elytra light yellowish green; abdomen above black. Fore parts and legs, particularly the face and the latter, frequently tinged with red. Length, 2⅓–2¾ mm.

On *Carices*, Findhorn Marsh, Forres, Morayshire (*Norman*). It is said to occur on *Calluna* in August and September.

iii. Kybos, *Fieb.* (Pl. III., fig. 20.

Fieb., Cicad. d'Eur., pt. i., 127 (1876).

Body moderately stout. Crown one-half or less than half as long as the pronotum, its front and hind margins feebly curved, subparallel. Ocelli distinct. Elytra longer than the abdomen; second apical area triangular; appendix wanting. Submarginal wing-nerve running into the confluent continuation of the first and

second nerves; third wing-nerve simple, joined to the second by a transverse nerve. Genital valve well-developed in the male.

1. *Kybos smaragdula*, Fall.

Cicada smaragdula, Fall., Hem. Suec., ii., 53, 46.
Cicadula smaragdula, Zett., Ins. Lap., 298, 9; J. Sahl., Not. Fenn., xii., 159, 1.
Typhlocyba smaragdula, H.-Scff., Deuts. Ins., 124, 8, and 164, 16; Flor, Rhyn. Liv., ii., 393, 8; Kirschb., Cicad., 178, 2.
Eupteryx viridipes, Curt., Brit. Ent., 640, 9.
E. smaragdulus, Marsh., Ent. Mo. Mag., iii., 219, 5.
Kybos smaragdulus, Leth., Cat. Hem. Nord., ed. ii., 65 and 81; Fieb., Cicad. d'Eur. (*Typhlocybini*), 27, 1.

Green or greenish yellow, shining; crown, pronotum, and scutellum with a narrow pale stripe; the latter is frequently bounded on each side by a dark stripe, or the upper fore parts are entirely reddish or dark brown. Inner margin of elytra generally bearing a fuscous stripe, which sometimes extends to the membrane; claval suture frequently narrowly fuscous. Abdomen above black; hind margins of the segments more or less widely pale. Legs green, claws black. Length, 4–3¼ mm.

Common on poplars, willows, and sallows.

iv. CHLORITA, *Fieb.* (Pl. III., fig. 22).
Fieber, Cicad. d'Eur., pt. i., 126 (1876).

Elongate, delicate species, pale green in colour. Crown (with the eyes) crescent-shaped, more or less pointed. Elytra longer than the abdomen; second apical area oblong; appendix wanting. Neuration of the wings as in the last genus. Genital valve wanting in the male.

Our two species may be thus distinguished:—

Suprabrachial area hyaline throughout.. ..	1. *flavescens*.
Suprabrachial area hyaline at the apex only ..	2. *viridula*.

1. *Chlorita flavescens*, Fab.

Cicada flavescens, Fab., Ent. Syst., iv., 46, 85; Sys. Rhyn., 79, 85.
Typhlocyba flavescens, Flor, Rhyn. Liv., ii., 394, 9; Kirschb., Cicad., 178, 3.

Eupteryx flavescens, Marsh., Ent. Mo. Mag., iii, 220, 6.
Cicadula flavescens, J. Sahl., Not. Fenn., xii., 161, 3.
Chlorita flavescens, Fieb., Cicad. d'Eur. (*Typhlocybini*), 18 and 25.

Yellowish green; a spot in the apex of the subcostal area, the entire suprabrachial area, a large subtriangular spot in the apex of the brachial area, and the membrane, hyaline; the latter very faintly tinged with fuscous. The white silky hairs on the apex of the male genital plates twice as long as the erect bristles which clothe the other portions of the same. Length, 3½—4 mm.

Common on various trees and bushes throughout the autumn, and on firs in winter and spring. Judging from a type received from Norman, this species is the *C. apicalis* of his Morayshire list (Ent. Mo. Mag., xv., 256).

2. *Chlorita viridula*, Fall.

Cicada viridula, Fall,, Hem. Suec.. ii., 53, 47.
Typhlocyba viridula, H.-Scff., Deuts. Ins., 161, 14 and 16; Flor, Rhyn. Liv., ii., 392, 7; Kirschb., Cicad., 178, 4.
Eupterpx Solani, Curt., Morton's Cyclop. Agric., i., 772.
E. viridulus, Marsh., Ent. Mo. Mag., iii., 219, 4.
Cicadula viridula, J. Sahl., Not. Fenn., xii., 160, 2.
Chlorita viridula, Fieb., Cicad. d'Eur. (*Typhlocybini*), 22 and 25.

Green, with pale or white markings on the head, pronotum, and scutellum; these markings are very variable, and are best seen in the fresh insect; the most constant of them seems to be a white stripe on the basal two-thirds of the scutellum. A spot in the apex of the subcostal and suprabrachial areas, a large subtriangular spot in the apex of the brachial area, and the membrane, hyaline; the latter very faintly tinged with fuscous. The white silky hairs on the apex of the male genital plates subequal in length to the erect bristles on the remainder of the same. Length, 3 mm.

Equally common with the last, and frequently taken in company with it. *C. apicalis*, Flor, has been recorded as British, but it seems to me in error; Marshall's exponents of it consisted of several different species of *Typhlocyba*, and a reputed example in Douglas' collection is certainly *C. viridula*. Lethierry, Fieber, and Ferrari

recognise a species, *C. solani*, Koll., which ought to occur here. It has the head narrower than the pronotum, and Ferrari says that it has the suprabrachial area hyaline, while Lethierry and Fieber credit it with unicolorous elytra. It is remarkable that Lethierry does not include *C. viridula* in his Cat. Hem. Dept. du Nord.

v. EUPTERYX, *Curt.* (Pl. III., 25).

Curtis, Ent. Mag., i. (1832).

Body elongate. Crown for the most part crescent-shaped. Elytra much longer than the abdomen; apical areas four, the second triangular; appendix wanting. Submarginal wing-nerve incomplete; first and second wing-nerves simple, as well as the third, the two former connected near the apex by a short transverse nerve, the latter joined by a transverse nerve to the second nerve above and the submarginal nerve below.

TABLE OF SPECIES.

1 (4). Elytra obliquely subtruncate at apex.
2 (3). Length, 3 mm. .. .. 1. *vittatus.*
3 (2). Length, 2—2½ mm. .. .. 2. *notatus.*
4 (1). Elytra evenly rounded at apex.
5 (24). Head across the eyes as wide or wider than the pronotum.
6 (7). Hind tibiæ black, widely pale at the base .. 3. *urticæ.*
7 (6). Hind tibiæ entirely pale, or only black at the extreme apex.
8 (19). Elytra with a black spot on the costa, or the inner margin, or both.
9 (14). Nerve forming the upper boundary of the fourth apical area springing from the middle of the apex of the subcostal area.
10 (11). Length, 3½ mm. .. .. 4. *stachydearum.*
11 (10). Length, 3 mm.
12 (13). Crown with two black spots on the hind margin, confluent behind, and forming a V 5. *collinus.*
13 (12). Hind margin of the crown with one black spot, which is generally small and roundish 6. *melissæ.*
14. (9). Nerve forming the upper boundary of the fourth apical area springing from about the middle of the apex of the suprabrachial area, or continuous with the brachial nerve.
15 (18). Pronotum with two large subreniform black spots.
16 (17). Length, 4 mm. Sides of the face longer than its width including the eyes .. .. 7. *auratus.*

17 (16).	Length, 3½ mm. Sides of the face shorter than its width including the eyes ..	8. *carpini.*
18 (15).	Pronotum unspotted, or, if spotted, the spots small and not subreniform	9. *signatipennis.*
19 (8).	Elytra without black spots on the costa or inner margin.	
20 (21).	Elytra with alternate pale and fuscous stripes	10. *tenellus.*
21 (20).	Elytra not striped.	
22 (23).	Elytra pale green, generally infuscated down the middle	11. *abrotani.*
23 (22).	Elytra yellow, more or less tinged with fuscous at the apex	12. *filicum.*
24 (5).	Head across the eyes narrower than the pronotum.	
25 (26).	Elytra without markings	13. *Germari.*
26 (25).	Elytra with a fine oblique black line about the middle of the costa.	
27 (28).	A deep black round spot on the membrane..	14. *pulchellus.*
28 (27).	Membrane without any round black spot ..	15. *concinna.*

1. *Eupteryx vittatus*, Lin.

Cicada vittata, Lin., Faun. Suec., ed. i., 634; ed. ii., 242, 893; Sys. Nat., v., 463, 36; Fall. Hem. Suec., ii., 56, 58.
Cicadula vittata, Zett., Ins. Lap., 299, 17.
Typhlocyba vittata, H.-Scff., Deuts. Ins., 164, 16; Burm., Handb., ii., 107, 3; Flor, Rhyn. Liv., ii., 426, 30; Kirschb., Cicad., 193, 36; Leth., Cat. Hem. Nord., ed. ii., 70; Fieb., Cicad. d'Eur. (*Typhlocybini*), 29, 1.
T. 4-signata, Hardy, Trans. Tynes. F. C., i., 418, 5.
Eupteryx vittatus, Marsh., Ent. Mo. Mag., iii., 267, 25; J. Sahl., Not. Fenn., xii., 190, 1.

Head yellow; hind part of crown blackish brown, with a pale middle stripe. Pronotum blackish brown, sometimes with a few (3 to 5) pale points. Scutellum blackish brown, a fine middle stripe and the apex yellow. Corium blackish brown, a large irregular patch on the costa reaching half-way across the elytron, a subtriangular spot in the apex of the costal area, and a semicircular spot on the inner margin just below the apex of the scutellum, yellow; membrane blackish brown, a roundish spot in the base of the fourth apical area, two spots in the third apical area, a minute point in the base of the second apical area, a large roundish spot occupying almost the whole of the first apical area, and the apex narrowly, shining white; on the apex of the nerve

dividing the first apical area from the second a small roundish yellow spot. Abdomen in the male black, hind margins of the segments yellow, genital plates yellow; in the female, above black with yellow hind margins to the segments, beneath yellow, pygofer black. Breast and legs yellow. Length, 3 mm.

Very common amongst low plants in damp places.

2. *Eupteryx notata*, Curt.

Eupteryx notata, Curt., Brit. Ent., xiv., 640, 1.
E. Wallengreni, J. Sahl., Not. Fenn., xii., 191, 2.
E. diminuta, Ferrari, Cicad. agri Ligust., 78.
Typhlocyba Wallengreni, Stal, Ofv., 177, 7 (1854); Fieb., Cicad. d'Eur. (*Typhlocybini*), 31, 3.
T. diminuta, Kirschb., Cicad., 191, 17; Leth., Cat. Hem. Nord., ed. ii., 70.

Like the preceding species in colour and facies, but one-third smaller, with the crown more pointed. Length, 2—2½ mm.

Common amongst low plants in waste places.

3. *Eupteryx urticæ*, Fab.

Cicada urticæ, Fab., Sys. Rhyn. 77, 76; Fall., Hem. Suec., ii., 50, 41.
Cicadula urticæ, Zett., Ins. Lap., 299, 16.
Typhlocyba urticæ, H.-Scff., Deuts. Ins., 124, 4; Flor, Rhyn. Liv., ii., 428, 31; Kirschb., Cicad., 195, 38; Leth., Cat. Hem. Nord., ed. ii., 71; Fieb., Cicad. d'Eur. (*Typhlocybini*), 41, 12.
Eupteryx tarsalis, Curt., Brit. Ent., xiv., 640, 6.
E. urticæ, Marsh., Ent. Mo. Mag., iii., 268, 26; J. Sahl., Not. Fenn., xii., 193, 4; Ferrari, Cicad. agri Ligust., 79.

Frons yellow, sides and apex frequently black, just below the forehead a pair of black points. Crown yellow, a triangular spot on the hind margin and two roundish spots on the disc black. Pronotum yellow, with a black spot on each side and about four others on the front margin, on the hinder half a double fuscous middle stripe bounded on each side by a black triangular spot. Scutellum yellow, with two black spots at the base. Elytra greenish white; clavus with two streaks at the base, a suboval spot in the middle, and the apex, fuscous; brachial area fuscous; suprabrachial area apparently divided into two, of which the basal

one is filled up with fuscous and the other is margined with the same colour, more widely at the base and apex; the apical half of the subcostal area is also margined with fuscous in a similar manner; on the costa two oblique black spots, one before, the other which reaches the suprabrachial area, just behind the middle. Membrane dark fuscous, a spot at the base of the fourth apical area, an irregular interrupted band across the middle, the apex rather widely, and a small roundish spot on the apex of the nerve dividing the first apical area from the second, white. Breast and abdomen black; hind margins of the segments of the latter narrowly yellow. Legs yellow; hind tibiæ black, except at the base; apex of the hind tarsi black in the male. Length, 3¼—3½ mm.

Very common amongst nettles.

4. *Eupteryx stachydearum*, Hardy.

Typhlocyba stachydearum, Hardy, Trans. Tynes. F. C., i., 422, 9.
T. Curtisii, Flor, Rhyn. Liv., ii., 431, 32; Leth., Cat. Hem. Nord., ed. ii., 72; Fieb., Cicad. d'Eur. (*Typhlocybini*), 44, 13.
T. Zelleri, Kirschb., Cicad., 195, 40.
Eupteryx stachydearum, Marsh., Ent. Mo. Mag., iii., 268, 28.
E. hortensis, Curt., Brit. Ent., xiv., 640, 5 (forte).

Head, pronotum, and scutellum yellow, with dark markings as in *E. urticæ*, save that the spot on the back of the crown is generally transversely suboval and somewhat irregular in outline, and the double stripe on the hind part of the pronotum is more or less suffused over the disc. Elytra greenish white, the areas a little darker and narrowly margined with fuscous, the costal spot nearest the base obsolete, and the one beyond the middle divided by the pale nerve, which separates the costal area from the subcostal. Membrane dark fuscous, a spot in the fourth apical area, a bisinuate band across the middle, the apex very narrowly, and a large roundish spot on the first apical area, white. Breast and abdomen black, hind margins of the segments of the latter yellow. Legs yellow: ♂; hind tibiæ narrowly black at the apex, some fuscous spines as well as pale ones on the outer side, first joint of hind tarsi black, pale on the basal third or a little more, third joint fuscous at the extreme apex; ♀ generally with the extreme apex of the hind tibiæ and tarsi fuscous, but very frequently the basal joint of the hind tarsi is fuscous at the apex. Length, 3½ mm.

Very common on Labiates, particularly on *Teucrium scorodonia*. Easily distinguished from the two following species by its larger size and darker colour. The two points on the frons are not unfrequently wanting in the male.

5. *Eupteryx collinus*, Flor.

Typhlocyba collina, Flor, Rhyn. Liv., ii., 433, 33; Kirschb., Cicad., 196, 42; Leth., Cat. Hem. Nord., ed. ii., 72; Fieb., Cicad. d'Eur. (*Typhlocybini*), 45.

Similar to the preceding, but smaller and paler, and having the basal black spot on the crown always V-shaped. Legs yellow: ♂; hind tibiæ narrowly black at the apex, with some of the spines on the outer side fuscous, first joint of the hind tarsi black on the apical third or a little less, third joint black, pale at the base: ♀; hind tarsi dark only at the extreme apex, outer edge of hind tibiæ without fuscous spines. Length, 3 mm.

Locally abundant on *Ballota nigra* at Norwich.

6. *Eupteryx melissæ*, Curt.

Eupteryx melissæ, Curt., Brit. Ent., xiv., 640, 7; Marsh., Ent. Mo. Mag., iii., 268, 27; Ferrari, Cicad. agri Ligust., 79.

Typhlocyba melissæ, Leth., Cat. Hem. Nord., ed. ii., 72 and 84; Fieb., Cicad. d'Eur. (*Typhlocybini*), 44.

Very similar to the last in size and appearance, but the basal black spot on the crown is never V-shaped. Legs yellow, only the extreme apex of the tarsi fuscous. Very rarely in the male the hind legs are coloured as in that sex of *E. collinus*, but there are no fuscous spines on the outer edge of the hind tibiæ in either sex. Length, 3 mm.

On various Labiates; not uncommon.

7. *Eupteryx auratus*, Lin.

Cicada aurata, Lin., Faun. Suec., ed. i., 635; ed. ii., 243, 899; Sys. Nat., 466, 48; Fab., Sys. Rhyn., 78, 80; Fall., Hem. Suec., ii., 50, 40.

Typhlocyba aurata, H.-Scff., Nom. Ent., 68; Flor, Rhyn. Liv., 423, 28; Kirschb., Cicad., 192, 33; Leth., Cat. Hem. Nord., ed. ii., 71; Fieb., Cicad. d'Eur. (*Typhlocybini*), 54, 21.

T. picta, Burm., Handb., ii., 107, 2.
T. fulva, H.-Scff., Deuts. Ins., 143, 1.
Eupteryx auratus, Marsh., Ent. Mo. Mag., iii., 266, 23; J. Sahl., Not. Fenn., xii., 194, 5; Ferrari, Cicad. agri Ligust., 79.

Fore parts yellow or greenish yellow; sides and apex of the frons sometimes black; on the crown two large black spots, which are occasionally more or less confluent behind; on the pronotum a large sometimes subreniform black spot on each side, and often a pair of black points near the front margin; scutellum with two large black spots at the base, which sometimes leave only a fine middle stripe and the apex pale. Elytra yellow or greenish yellow, with a wide irregular fuscous stripe down the middle; on the costa near the base an oblique black line, and just beyond the middle a large black spot; on the middle of the inner margin a round black spot. Membrane fuscous, a large spot in the first, third, and fourth apical areas, a minute spot on the apex of the nerve dividing the first and second apical areas, and the apex broadly, white. Abdomen black; hind margins of the segments more or less narrowly yellow; genital plates yellow. Legs entirely yellow. Length, 4 mm.

Sparingly on mint at Norwich in company with *E. carpini*, *E. stachydearum*, and *E. melissæ*; probably widely distributed, but overlooked. Marshall (*l. c.*, 267) considered this species sufficiently common throughout the country, but it has scarcely been recognised with certainty since the time he wrote.

8. *Eupteryx carpini*, Fourc.

Cicada carpini, Fourc., Ent. Par., i., 191, 25.
C. picta, Fab., Ent. Syst., iv., 42, 67; Sys. Rhyn., 71, 76.
Tettigonia picta, H.-Scff., Deuts. Ins., 112, 23.
Typhlocyba picta, id., *l. c.*, 169, 16; Flor, Rhyn. Liv., ii., 427, 29; Kirschb., Cicad., 193, 34.
T. aureola, Boh., Sv. Ak. Handl., 49, 23 (1847).
T. carpini, Leth., Cat. Hem. Nord., ed. ii., 77; Fieb., Cicad. d'Eur. (*Typhlocybini*), 53, 20.
Eupteryx pictus, Marsh., Ent. Mo. Mag., iii., 267, 24; J. Sahl., Not. Fenn., xii., 195, 6.
E. carpini, Ferrari, Cicad. agri Ligust., 79.

Similar to the preceding, but smaller, with all the dark markings much reduced. The fuscous stripe down the elytra is very

frequently more or less interrupted on the disc, when the dark markings consequently take the form of two irregular curved bands, one before and the other behind the middle; this band-like arrangement of the markings is best appreciated when the elytra are closed. Genital plates black, the outer sides and apices broadly yellow. Length, 3½ mm.

Very abundant on various low plants, and especially Labiates, in gardens and elsewhere in autumn.

9. *Eupteryx signatipennis*, Boh.

Typhlocyba signatipennis, Boh., Sv. Ak. Handl., 36, 8 (1849).

Eupteryx signatipennis, Marsh., Ent. Mo. Mag., iii., 247, 15; J. Sahl., Not. Fenn., xii., 196, 7; Fieb., Cicad. d'Eur. (*Typhlocybini*), 55.

Face yellow; upper fore parts very pale green, sometimes with a pair of black triangles on the base of the scutellum, and more rarely a black point on each side of the pronotum with or without some indication of a pair of spots on the crown. Elytra very pale green, the brachial area and the apical half of the suprabrachial and subcostal areas whitish hyaline, near the costa beyond the middle a small black spot and a round black spot on the inner margin about the middle, the disc occasionally with some ill-defined fuscous stripes; rarely the elytra are without spots. Membrane whitish hyaline, more or less suffused with fuscous and frequently having an ill-defined blackish spot near the apex of the first apical area. Abdomen black; hind margins of the segments very narrowly pale. Legs entirely pale yellow. Length, 3½ mm.

On *Spiræa ulmaria*; local.

10. *Eupteryx tenellus*, Fall.

Cicada tenella, Fall., Act. Holm., 43 (1806); Hem. Suec. ii., 52, 44.

Typhlocyba tenella, H.-Scff., Deuts. Ins., 164, 16; Flor, Rhyn. Liv., ii., 421, 27; Kirschb., Cicad., 191, 32; Fieb., Cicad. d'Eur. (*Typhlocybini*), 49, 17.

T. pulchella, H.-Scff., *l. c.*, 124, 6.

Eupteryx tenella, J. Sahl., Not. Fenn., xii., 192, 3; Doug., Ent. Mo. Mag., xii., 204.

Head yellow, sides and apex of the frons frequently black, two large round spots on the forehead, and a transversely suboval one

on the base of the crown, black. Pronotum fuscous, broadly yellow in front. Scutellum yellow, with a large black spot on each side of the base. Elytra pale green, the suprabrachial area and the membrane fusco-hyaline; a stripe in the subcostal area, a rather wide regular one along the claval suture, and the scutellar margin narrowly, dark fuscous. Abdomen black, margins of the segments more or less widely yellow. Legs yellow; the extreme apex of the tarsi fuscous. Length, 3 mm.

Scarce. Birdbrook, Essex (*Power*); on *Achillea millefolium* near Norwich.

11. *Eupteryx abrotani*, Dougl.

Eupteryx abrotani, Dougl., Ent. Mo. Mag., xi., 118; Fieb., Cicad. d'Eur. (*Typhlocybini*), 56.

Face yellow; upper fore parts pale green without markings. Elytra pale greenish yellow, the nerves of the disc generally margined with fuscous; membrane whitish hyaline, the pale green nerves very broadly murgined with fuscous. Abdomen black; hind margins of the segments sometimes very narrowly yellow. Legs yellow, claws fuscous. Length, 3 mm.

On *Artemisia abrotanum* and *maritima*; abundant where it occurs.

12. *Eupteryx filicum*, Newm.

Typhlocyba filicum, Newm., Trans. Ent. Soc. Lond., 2nd ser., ii., Proceed., 132, 3; Leth., Cat. Hem. Nord., ed. ii., 73; Fieb., Cicad. d'Eur. (*Typhlocybini*), 34, 6.
Eupteryx filicum, Marsh., Ent. Mo. Mag., iii., 247, 16.

Fore parts yellow; pronotum sometimes tinged with red in the male. Elytra yellow or golden yellow, a spot in the apex of the brachial, suprabrachial, and subcostal areas, and the membrane, fuscous; the latter with about three large whitish hyaline spots. Abdomen black; hind margins of the segments more or less widely yellow. Legs yellow, sometimes tinged with red. Length, 3½ mm.

On ferns; local and scarce. London (*Douglas*), Milford (*Marshall*).

13. *Eupteryx Germari*, Zett.

Cicadula Germari, Zett., Ins. Lap., 301, 23.
Typhlocyba Germari, H.-Scff., Deuts. Ins., 164, 16; Flor, Rhyn. Liv., ii., 420, 26; Kirschb., Cicad., 189, 28; Leth., Cat. Hem. Nord., ed. ii., 72; Fieb., Cicad. d'Eur. (*Typhlocybini*), 33, 5.
Eupteryx Germari, Marsh., Ent. Mo. Mag., iii., 266, 22; J. Sahl., Not. Fenn., xii., 213, 11.

Upper side greenish grey; membrane whitish hyaline, fumose round the apex. Elytra subopaque, suprabrachial area and the apical half of the subcostal area whitish hyaline. Nerves of the membrane fuscous from the apex forwards. Wings fumose, longitudinal nerves black. Abdomen black; hind margins of the segments more or less narrowly yellow. Legs greenish grey. Length, 4—4½ mm.

On Scotch firs; not uncommon.

14. *Eupteryx pulchellus*, Fall.

Cicada pulchella, Fall., Hem. Suec., ii., 55, 51.
Cicadula pulchella, Zett., Ins. Lap., 301, 22.
Typhlocyba pulchella, Flor, Rhyn. Liv., ii., 418, 25; Kirschb., Cicad., 190, 30; Leth., Cat. Hem. Nord., ed. ii., 70; Fieb., Cicad. d'Eur. (*Typhlocybini*), 36, 8.
Eupteryx pulchellus, Marsh., Ent. Mo. Mag., iii., 266, 21; J. Sahl., Not. Fenn., ii., 199, 10.
E. ornatipennis, Curt., Brit. Ent., xiv., pl. 640.

Crown, pronotum, and scutellum yellow, the two latter frequently suffused with brown. Elytra lighter or darker yellow, more or less suffused with brown towards the apex of the corium, sometimes with a rosy tinge; an oblique line on the middle of the costa reaching outwardly to the subcostal area, the nerve at the apex of the costal area, and a conspicuous point on the nerve which separates the first from the second apical area, black. Membrane fuscous, the apex very narrowly, a spot at the base of the first apical area, and another in the third apical area, white; the nerve at the apex of the brachial area fuscous, and the space around it suffused with the same colour. Abdomen black above; hind margins of the segments more or less widely pale. Legs pale yellow. Length, 4—4½ mm.

Common, especially on oaks. Pale whitish examples

of this insect are not uncommon, but they may always be distinguished from the next species by the minute but constant differences in the pattern on the elytra.

15. *Eupteryx concinna*, Germ.

Tettigonia concinna, Germ., Faun. Ins. Eur., 14, 22.
Typhlocyba concinna, H.-Scff., Deuts. Ins., 164, 16; Leth., Cat. Hem. Nord., ed. ii., 70; Fieb., Cicad. d'Eur. (*Typhlocybini*), 35, 7.
Eupteryx concinna, Ferrari, Cicad. agri Ligust., 78 and 79.

Exceedingly like a pale whitish example of the last species, but although there is sometimes the faintest possible indication of the black spot on the nerve which divides the first from the secocnd apical area, it is never developed, and in place of the ill-defined brown line which bounds the apex of the brachial area in *E. pulchellus* the apices of both the brachial and suprabrachial areas in the present species are bounded by a sharply-defined black line. Length, 4—4½ mm.

Not uncommon on oaks; occurring with the last species. The distinctive characters given above are supplemented by great structural differences between the male genitalia of this species and *E. pulehellus*.

vi. Typhlocyba, *Germ.* (Pl. III., fig. 23).

Germar, Silb. Rev. Ent., i. (1833).

Body small, cylindrical. Crown crescent-shaped, more or less pointed. Elytra much longer than the abdomen, the four apical areas well-defined, the second triangular; membrane wanting. Submarginal wing-nerve incomplete; first and second wing-nerves confluent before the apex and running to the margin as one nerve; third wing-nerve simple, the straight transverse nerve connecting it with the second wing-nerve, prolonged in a suboblique direction as far as the submarginal nerve.

This genus, as here limited, is equivalent to *Anomia*, Fieb. (Cicad. d'Eur., pt. i., 128). The species are mostly arboreal in their habits.

Table of Species.

1 (8).	Pronotum with one or more black spots.	
2 (5).	Two or more black spots on the pronotum.	
3 (4).	Disc of pronotum with an oval black spot down the middle	1. *jucunda.*
4 (3).	Disc of pronotum without any black marking in the middle	2. *sexpunctata.*
5 (2).	Pronotum with only one (punctiform) black spot.	
6 (7).	Nerves of the membrane not black at the apex	3. *debilis.*
7 (6).	Nerves of the membrane black at the apex ..	4. *ulmi.*
8 (1).	Pronotum not spotted with black.	
9 (26).	Elytra not striped or banded with dark brown.	
10 (25).	Elytra yellow, greenish yellow, or creamy white.	
11 (20).	Elytra yellow, membrane distinctly fuscous.	
12 (17).	Suture not fuscous.	
13 (14).	Nerves of the membrane black at the apex ..	5. *tenerrima.*
14 (13).	Nerves of the membrane not black at the apex.	
15 (16).	Abdomen chiefly black	6. *aurovittata.*
16 (15).	Abdomen pale	7. *Douglasi.*
17 (12).	Suture more or less broadly fuscous.	
18 (19).	Entire clavus more or less distinctly fuscous	8. *gratiosa.*
19 (18).	Suture narrowly fuscous	9. *cratægi.*
20 (11).	Elytra yellow or creamy white, membrane not or only very faintly tinged with fuscous.	
21 (22).	♂; elytra deep yellow, costa narrowly reddish: ♀; elytra pale yellow, apical areas hyaline	10. *Lethierryi.*
22 (21).	Not as above.	
23 (24).	Elytra varying in colour from pale yellow to milk-white, apical areas faintly tinged with fuscous. Penis with a tuft of four lanceolate leaf-like appendages at the apex. Lives on roses	11. *rosæ.*
24 (23).	Elytra very pale creamy white, scutellum tinged with pink, at least when fresh. Penis with a tuft of four falcate appendages at the apex. Lives on sallows	12. *salicicola.*
25 (10).	Elytra whitish, with large red spots	13. *quercus.*
26 (9).	Elytra striped or banded with dark brown.	
27 (28).	Elytra yellow, with two broad dark brown bands	14. *nitidula.*
28 (27).	Elytra yellow, with a narrow dark brown stripe along the claval suture	15. *geometrica.*

1. *Typhlocyba jucunda*, H.-S.

Typhlocyba jucunda. H.-Scff., Deuts. Ins., 144, 16; Flor, Rhyn. Liv., ii., 632; Kirschb., Cicad., 188, 27; J. Sahl., Not. Fenn., xii., 172, 1; Ferrari, Cicad. agri Ligust., 82; Fieb., Cicad. d'Eur. (*Typhlocybini*), 48, 16.
T. Zetterstedti, Boh., Sv. Ak. Handl., 47, 22 (1847).
Eupteryx jucundus, Marsh., Ent. Mo. Mag., iii., 265, 19.

Upper side yellow or greenish yellow, with black spots; elytra with fuscous stripes. Crown with two roundish black spots in front. Pronotum with an oval spot down the middle, a large round spot on each side, a point near each hind angle, and two others on the front margin black. Scutellum black, with two V-shaped lines across the base and the apex yellow. Elytra with two stripes in the clavus, a cuneate spot in the apex of the brachial area, the entire suprabrachial area, a stripe in the apical half of the subcostal area, and the membrane, fuscous; nerves of the latter yellow. Wings fumose, principal nerves black. Abdomen black; hind margins of the segments very narrowly yellow. Legs yellow, claws black. Length, 4 mm.

On alders; not uncommon.

2. *Typhlocyba sexpunctata*, Fall.

Cicada 6-punctata, Fall., Hem. Suec., ii., 51, 43.
C. 10-punctata, Fall., Act. Holm., 41, 46 (1806); Hem. Suec., ii., 51, 42.
Cicadula 10-punctata, Zett., Ins. Lap., 300, 21.
Typhlocyba 6-punctata, H.-Scff., Deuts. Ins., 143, 2, and 164, 16; Ferrari, Cicad. agri Ligust., 82.
T. 10-punctata, Flor, Rhyn. Liv., ii., 409, 20; Kirschb., Cicad., 188, 26; J. Sahl., Not. Fenn., xii., 173, 2.
Eupteryx 10-punctatus, Marsh., Ent. Mo. Mag., iii., 248, 17.
Anomia 6-punctata, Leth., Cat. Hem. Nord., ed. ii., 74.
A. 10-punctata, Fieb., Cicad. d'Eur. (*Typhlocybini*), 58, 2.

Upper side very pale greenish yellow or rosy, with small black spots; elytra with fuscous markings, which form two irregular curved bands. Frons fuscous in the male, generally yellow in the female; forehead in both sexes with two small roundish black spots. Pronotum with a roundish black spot on each side behind,

and two or four others near the front margin. Scutellum with a black triangle on each side at the base, their apices often confluent. Elytra with an ill-defined oblique half-band running backwards from the costa near the base, another ill-defined oblique half-band running forwards from the apex of the clavus, and a spot on the base of the clavus next its suture, fuscous; on the middle of the inner margin of the clavus a roundish black spot. Membrane hyaline, with a fuscous tinge, except in the fourth apical area; nerve at the apex of the costal area black, its immediate neighbourhood dark fuscous; nerves bounding the second and third apical areas blackish from the apex forward. Abdomen black; hind margin of the segments yellow. Legs yellow; hind tibiæ sometimes fuscous on the apical half in the male. Length, 3½ mm.

Not uncommon on sallows in autumn.

3. *Typhlocyba debilis*, Dougl.

Typhlocyba debilis, Douglas, Ent. Mo. Mag., xii., 204; Lethierry, Fieb., Cicad. d'Eur. (*Typhlocybini*), 67.

♀. Upper side yellowish white, elytra tinged with yellow on the inner half, a spot in the apex of each of the areas of the corium and the membrane entirely fuscous; nerves of the latter pale. Two points on the forehead, one in the middle of the front margin of the pronotum and one on the apex of the scutellum, black. Abdomen black; hind margins of the segments narrowly white. Legs yellowish white, claws fuscous. Length, 3 mm.

Rare. Darenth, on oak; Addington Hills, on beech and blackthorn growing amongst other bushes; Norwich, on beech. In France it is said to occur on apple-trees. The male is undescribed.

4. *Typhlocyba ulmi*, Linn.

Cicada ulmi, Linn., Faun. Suec., 644; id., ed. ii., 243, 900; Sys. Nat., 467, 49; Fab., Sys. Rhyn., 78, 81; Fall., Hem. Suec., ii., 49, 39.
Typhlocyba ulmi, Flor, Rhyn. Liv., ii., 411, 21; Kirschb., Cicad., 186, 23; J. Sahl., Not. Fenn., xii., 176, 4.
Eupteryx ocellata, Curt., Brit. Ent., xiv., 640, 8.
E. ulmi, Marsh., Ent. Mo. Mag., iii., 248, 18.
Anomia ulmi, Leth., Cat. Hem. Nord., ed. ii., 74; Fieb., Cicad. d'Eur. (*Typhlocybini*), 63, 8.

Upper side greenish yellow; forehead with a pair of black points in the female only; a minute black point in the middle of the front margin of the pronotum in both sexes; scutellum frequently black or blackish in the male. Elytra with a fuscous band across the apex of the corium; membrane faintly fumose, darker round the edge, its nerves black for a short distance forward from the apex. Abdomen black; hind margins of the segments narrowly yellow. Legs yellow, claws fuscous. Length, 3¾—4 mm.

Very abundant on elms.

5. *Typhlocyba tenerrima*, H.-S.

Typhlocyba tenerrima, H.-Scff., Deuts. Ins., 124, 10 *a*, and 164, 16; Kirschb., Cicad., 185, 19; J. Sahl., Not. Fenn., xii., 178, 6; Dougl., Ent. Mo. Mag., xii., 28, 5; Ferrari, Cicad. agri Ligust., 82.
T. rubi, Hardy, Trans. Tynes. F. C., i., 417, 3.
T. misella, Boh., Sv. Ak. Handl., 122 (1853).
Anomia tenerrima, Leth., Cat. Hem. Nord., ed. ii., 74; Fieb., Cicad. d'Eur. (*Typhlocybini*), 65, 11.

Fore parts and legs yellowish white. Elytra whitish hyaline, with three broad yellow stripes, one along the costa, one just above the claval suture, and the other on the inner margin of the clavus; an ill-defined broad fuscous band, on which the whitish nerves are conspicuous, crosses the apex of the corium and the base of the membrane; the latter faintly fumose, darker round the edge, its nerves black for a very short distance forward from the apex. Abdomen black; hind margins of the segments narrowly yellow. Claws fuscous. Length, 3 mm.

Common on brambles. One or more of the yellow stripes on the elytra are sometimes wanting.

6. *Typhlocyba aurovittata*, Dougl.

Typhlocyba aurovittata, Dougl., Ent. Mo. Mag., xii., 76, 6.

Head yellow or whitish yellow. Pronotum white, with a broad yellow stripe on each side of the disc. Scutellum yellow, sometimes with two reddish triangles on the base. Elytra yellow, with two rather broad whitish hyaline stripes, one along the costa and the other along the claval suture; a subquadrate spot in the apex of the brachial area and the membrane fuscous; nerves of the latter entirely pale. Abdomen black; hind margins of the

segments narrowly whitish. Legs pale yellow, claws fuscous. Length, 3½ mm.

Sparingly on oak bushes in hedges in November.

7. *Typhlocyba Douglasi*, Edw.

Typhlocyba Douglasi, Edw., Ent. Mo. Mag., xiv., 248, fig. 1 (style); *op. cit.*, xviii., 224, fig. *c* (penis); Lethierry, Fieb., Cicad. d'Eur. (*Typhlocybini*), 67.

Head, pronotum, and scutellum pale yellow; elytra deep yellow, inclining to orange in the male, pale yellow or whitish in the female; a subcuneate spot in the apex of the brachial, suprabrachial, and subcostal areas, and the membrane, fuscous. Abdomen entirely yellow. Legs pale yellow, claws fuscous. Length, 3½ mm.

On beech; common.

8. *Typhlocyba gratiosa*, Boh.

Typhlocyba gratiosa, Boh., Sv. Ak. Handl., 121 (1853); J. Sahl., Not. Fenn., xii., 179, 8; Dougl., Ent. Mo. Mag., xii., 76, 9.

T. suturalis, Flor, Rhyn. Liv., ii., 634; Kirschb., Cicad., 186, 22.

Eupteryx apicalis, var., Marsh., Ent. Mo. Mag. iii., 220, 7, sec. spec. comm.

Anomia gratiosa, Leth., Cat. Hem. Nord., ed. ii., 78.

A. suturalis, Fieb., Cicad. d'Eur. (*Typhlocybini*), 61, 7.

♂. Head, pronotum, and scutellum yellowish white. Elytra yellow, a streak in the apex of the subcostal, suprabrachial, and brachial areas, and the membrane, fuscous; clavus tinged with fuscous, especially on the claval suture and the inner margin. Abdomen and legs yellow, claws fuscous. ♀ yellowish white; the entire clavus, a streak in the apex of the subcostal, suprabrachial, and brachial areas, and the membrane, fuscous. Claws fuscous. Length, 3½ mm.

On beech; not very common. The male very rarely has the clavus so dark as the female.

9. *Typhlocyba cratægi*, Dougl.

Typhlocyba cratægi, Dougl., Ent. Mo. Mag., xii., 208.

Pale yellow; the membrane, a small spot in the apex of the subcostal and suprabrachial areas, and the inner margin of the

elytra narrowly and evenly, fuscous. Costa narrowly reddish in the male. Abdomen entirely yellow. Legs pale yellow, claws fuscous. Length, 3 mm.

On whitethorn; not very common. Lethierry's description (Fieber's Cicad. d'Eur. (*Typhlocybini*) p. 67) is not very characteristic of this species.

10. *Typhlocyba Lethierryi*, Edw.

Typhlocyba Lethierryi, Edw., Ent. Mo. Mag., xvii., 224, fig. *a* (penis).
T. sulphurella, Ferrari, Cicad. agri Ligust., 83.
Anomia sulfurella, Leth., Cat. Hem. Nord., ed. ii., 75; Fieb., Cicad. d'Eur. (*Typhlocybini*), 60, 5.

♂. Deep yellow inclining to orange. Elytra with the costa generally and the inner margin sometimes narrowly reddish; membrane and generally a spot in the apex of the subcostal, suprabrachial, and brachial areas pale fusco-hyaline. Hind tibiæ generally tinged with pink. Claws fuscous. Penis divided at the apex into three branches, of which the hinder one is trifid, and the other two, which spring from a short common stem, are bifid. ♀ pale yellow. Membrane and three spots on the apex of the corium pale fusco-hyaline. Length, 3½ mm.

Occurs on various trees: maple, hornbeam, black poplar, elm, and lime. This species, although sufficiently distinct from its allies in the structure of the male genitalia, is not always easy to identify without a reference to those organs. The head and pronotum in highly-coloured males are yellow, sometimes tinged or marked with red; but less highly-coloured examples of that sex have the head and pronotum white, and the elytra nearly resembling those of male *Douglasi*, from which they may be distinguished by the paler membrane. The female is always much stouter and yellower than female *rosæ*, and has not the fuscous membrane which distinguishes that sex of *Douglasi*.

11. *Typhlocyba rosæ*, Linn.

Cicada rosæ, Linn., Faun. Suec., ed. i., 645; ed. ii., 344, 902; Sys. Nat., 467, 50.
Cicadula rosæ, Zett., Ins. Lap., 300, 14.
Typhlocyba pteridis, Dahlb., Sv. Ak. Handl., 179 (1851).

T. rosæ, Flor, Rhyn. Liv., ii., 407, 17; Kirschb., Cicad., 184, 17; J. Sahl., Not. Fenn., xii., 180, 9; Ferrari, Cicad. agri Ligust., 88.
T. lactea, Dougl., Ent. Mo. Mag., xii., 77, 10, sec. spec. comm.
Eupteryx rosæ, Marsh., Ent. Mo. Mag., iii., 246, 10.
Anomia rosæ, Leth., Cat. Hem. Nord., ed. ii., 74; Fieb., Cicad. d'Eur. (*Typhlocybini*), 60, 4.

Head and pronotum white. Scutellum yellowish white. Elytra very pale yellow, dull white more or less tinged with yellow from the suture outwards, or entirely dull white; a spot in the apex of the brachial, suprabrachial, and subcostal areas, and the membrane, very faintly tinged with fuscous. Abdomen entirely yellow. Legs pale yellow, claws fuscous. Length, 3½—3⅔ mm.

Very common; lives on roses. I have figured the penis of this species in Ent. Mo. Mag., xvii., p. 224, fig. *b*.

12. *Typhlocyba salicicola*, Edw.

Typhlocyba salicicola, Edw., Ent. Mo. Mag., xxi., 230, p. 229, fig. 2 *a* (penis).

Somewhat larger and decidedly stouter than *T. rosæ*. Very pale yellowish white; scutellum tinged with pink, at least in fresh examples. Membrane very faintly fusco-hyaline. Length, 3½—4½ mm.

On sallows; common.

13. *Typhlocyba quercus*, Fab.

Cicada quercus, Fab., Ent. Syst., iv., 47, 88; Sys. Rhyn., 79, 89; Fall., Hem. Suec., ii., 56, 54.
Typhlocyba fasciata, Tollin, Stett. Ent. Zeit., xii., 78.
T. quercus, H.-Sch., Deuts. Ins., 164, 9 and 16; Flor, Rhyn. Liv., ii., 412, 22; Kirschb., Cicad., 187, 24; J. Sahl., Not. Fenn., xii., 175, 3.
Eupteryx quercus, Marsh., Ent. Mo. Mag., iii., 265, 20.
Anomia quercus, Leth., Cat. Hem. Nord., ed. ii., 74; Fieb., Cicad. d'Eur. (*Typhlocybini*), 64, 9.

Upper side white; a line just within the front margin of the crown, a semicircular line on the front and a roundish spot on the disc of the pronotum, a triangle on each side of the base of the scutellum, three large spots on the clavus, and two on the corium, orange-red; the apical half of the subcostal area, the angular

nerves, and those on the basal half of the membrane, margined with fuscous. On the costa near the middle a short oblique black line. Abdomen yellowish white, the basal segments more or less widely black. Length, 3½ mm.

Common on oaks.

14. *Typhlocyba nitidula*, Fab.

Cicada nitidula, Fab., Ent. Syst., iv., 48, 87; Sys. Rhyn., 79, 88.
Typhlocyba bifasciata, Boh., Ofv., 79, 39 (1853).
T. nitidula, H.-Scff., Deuts. Ins., 164, 10 and 16; Flor, Rhyn. Liv., ii., 407, 18; Kirschb., Cicad., 185, 20; J. Sahl., Not. Fenn., xii., 177, 5.
Eupteryx nitidulus, Marsh., Ent. Mo. Mag., iii., 247, 13.
Anomia nitidula, Leth., Cat. Hem. Nord., ed. ii., 73; Fieb., Cicad. d'Eur. (*Typhlocybini*), 59, 3.
A. Norgueti, Leth., *l. c.*

Pale yellow; the scutellum, a broad band across the base of the elytra, and another across the apex of the corium, blackish brown. Membrane whitish hyaline. Claws fuscous. Length, 3½—3¾ mm.

This species sometimes swarms on broad-leaved elms, but is very uncertain in its appearance; I once took it in quantity on Lombardy poplar. A variety of uncommon occurrence (*A. Norgueti*, Leth.) has the space between the two bands on the elytra filled up with blackish brown.

15. *Typhlocyba geometrica*, Schr.

Cercopis geometrica, Schrank, Faun. Boic., ii., 57, 1076.
Tettigonia geometrica, Germ., Faun. Ins. Eur., 12, 18.
Cicada lineatella, Fall., Hem. Suec., ii., 54, 50.
Cicadula lineatella, H.-Scff., Deuts. Ins., 143, 3, and 164, 16.
Typhlocyba plagiata, Hardy, Trans. Tynes. F. C., i., 416, 1.
T. geometrica, Flor, Rhyn. Liv., ii., 408, 19; Kirschb., Cicad., 186, 21; J. Sahl., Not. Fenn., xii., 178, 7.
Eupteryx geometricus, Marsh., Ent. Mo. Mag., iii., 247, 14.
Anomia geometrica, Leth., Cat. Hem. Nord., ed. ii., 73; Fieb., Cicad. d'Eur. (*Typhlocybini*), 61, 6.

Yellow; elytra with a narrow regular dark brown stripe along the claval suture. Scutellum with a dark brown stripe on each side, and the side margins of the apical half narrowly dark brown. Membrane fusco-hyaline, third and fourth apical areas fuscous. Claws fuscous. Length, 3¾—4 mm.

On alders; not very common.

vii. Zygina, *Fieb.* (Pl. III., fig. 24).

Fieber, Cicad. d'Europe, pt. i., 129 (1876).

Body generally very slender. Crown as in the preceding genus. Elytra much longer than the abdomen; first apical area very small, almost obsolete; the third oblong, parallel-sided; appendix wanting. Submarginal wing-nerve incomplete; first and second wing-nerves confluent before the apex, and running to the margin as one nerve; third wing-nerve simple, joined to the second by a straight transverse nerve, the nerve connecting it with the submarginal nerve very oblique.

Table of Species.

1	(2).	Species bright yellow, without markings ..	1. *alneti.*
2	(1).	Not as above.	
3	(8).	Elytra marked with red.	
4	(7).	Abdomen entirely pale, third apical area not more than half as wide as fourth.	
5	(6).	Hind tarsi in the male black on the apical half only	2. *blandula.*
6	(5).	Hind tarsi in the male entirely black.. ..	3. *tiliæ.*
7	(4).	Abdomen above black, sides yellow; third apical area about two-thirds as wide as fourth	4. *hyperici.*
8	(3).	Elytra without red markings.	
9	(10).	Crown with two round black spots, apex of scutellum pale	5. *parvula.*
10	(9).	Crown without black spots, apex of scutellum black	6. *scutellaris.*

1. *Zygina alneti*, Dahlb.

Cicadula alneti, Dahlb., Sv. Ak. Handl., 181 (1851).
Typhlocyba coryli, Tollin, Stett. Ent. Zeit., xii., 70, 12; Flor, Rhyn. Liv., ii., 404, 15; Kirschb., Cicad., 184, 16.
T. alneti, J. Sahl., Not. Fenn., xii., 181, 10; Dougl., Ent. Mo. Mag. xii., 77, 12; Ferrari, Cicad. agri Ligust., 83.

Zygina alneti, Leth., Cat. Hem. Nord., ed. ii., 75; Fieb., Cicad. d'Eur. (*Typhlocybini*), 68, 1.

Fore parts and legs pale yellow. Elytra bright yellow. Claws fuscous. Length, 3⅔ mm.

On alders; not uncommon. Specimens from hazel have the fore parts yellowish white and the elytra very pale flavo-hyaline. These may possibly prove specifically distinct from the insect which lives on alders, but having no males of the hazel insect at hand I am unable to compare the genitalia.

2. *Zygina blandula*, Rossi.

Cicada blandula, Rossi, Faun. Etr., ii., 217, 1263; Fall., Hem. Suec., ii., 57, 56.
Typhlocyba blandula, H.-Scff., Deuts. Ins., 164, 16; Flor, Rhyn. Liv., ii., 400, 13; Kirschb., Cicad., 183, 15; J. Sahl., Not. Fenn., xii., 184, 13.
T. quercus, H.-Scff., Deuts. Ins., 124, 7.
Eupteryx flammigera, Curt., Brit. Ent., xiv., 640, 2.
E. blandulus, Marsh., Ent. Mo. Mag., iii., 246, 10.
Zygina blandula, Leth., Cat. Hem. Nord., ed. ii., 77; Fieb., Cicad. d'Eur. (*Typhlocybini*), 78, 11; Ferrari, Cicad. agri Ligust., 86.

Crown and pronotum whitish yellow, with a fuscous or carmine-red middle stripe, which gradually widens from the apex of the crown to the base of the pronotum, and is generally divided down the middle by a pale line. Elytra whitish hyaline, with a fuscous zigzag stripe more or less covered with carmine-red atoms, on the inner margin; second and fourth apical areas generally fumose. Abdomen pale yellow. Legs whitish; the entire third joint of the hind tarsi and the apex of the second black in the male. Length, 2¾—3 mm.

In mixed hedges, and on various low plants; very common in autumn. Occasionally the carmine-red atoms extend to the nerves of the corium, but they are sometimes almost entirely absent.

3. *Zygina tiliæ*.

Cicada tiliæ, Fall., Hem. Suec., ii., 57, 55.
Zygina tiliæ, Leth., Cat. Hem. Nord., ed. ii., 77; Fieb., Cicad. d'Eur. (*Typhlocybini*), 78, 12; Ferrari, Cicad. agri Ligust., 86.

Typhlocyba tiliæ, Dougl., Ent. Mo. Mag., xii., 79; Edw., Ent. Mo. Mag.

Very similar to the preceding, but differs in the following particulars: the crown and pronotum are more decidedly yellow, and the stripe on them is almost obsolete, the carmine-red atoms on the elytra are much more sparingly distributed, and the hind tarsi of the male are black, except at the extreme base. Length, 3 mm.

I have never taken this species in summer or autumn, but have beaten it from ivy and spruce-fir in the spring in nearly equal numbers with *Z. blandula*.

4. *Zygina hyperici*, H.-S.

Typhlocyba hyperici, H.-Scff., Deuts. Ins., 143, 4; Flor, Rhyn. Liv., ii., 398, 12; Kirschb., Cicad., 183, 14; J. Sahl., Not. Fenn., xii., 137, 15.
T. coronula, Boh., Sv. Ak. Handl., 44, 19 (1847).
T. placidula, Stal, Ofv., 176, 6 (1854).
Eupteryx hyperici, Marsh., Ent. Mo. Mag., iii., 220, 9.
Zygina hyperici, Leth., Cat. Hem. Nord., ed. ii., 75; Fieb., Cicad. d'Eur. (*Typhlocybini*), 70, 4.

Crown and pronotum whitish yellow, with a dark purple-brown middle stripe, which gradually widens from the apex of the crown to the hind margin of the pronotum. Scutellum purple-brown. Elytra very pale flavo-hyaline, the inner margin as far as the apex of the clavus with a broad blood-red stripe. Abdomen above black, sides yellow. Legs yellow. Length, 2¼ mm.

Very rare. On *Hypericum perforatum* in woods as late as October. This species seems from descriptions to be just as variable in markings as the two preceding; pale varieties in which the only dark markings indicated are those on the pronotum and scutellum are not unfrequent, especially in the male. It is, however, well distinguished by its habitat and small size.

5. *Zygina parvula*, Boh.

Typhlocyba parvula, Boh., Sv. Ak. Handl., 46, 21 (1847); Flor, Rhyn. Liv., ii., 397, 11; Kirschb., Cicad., 182, 12; J. Sahl., Not. Fenn., xii., 138, 16.
T. 10-punctata, H.-Scff., Deuts. Ins., 124, 5.
Eupteryx parvulus, Marsh., Ent. Mo. Mag., iii., 220, 8.

Zygina parvula, Leth., Cat. Hem. Nord., ed. ii., 75; Fieb., Cicad. d'Eur. (*Typhlocybini*), 73, 6; Ferrari, Cicad. agri Ligust., 85.

Head yellow, sides and apex of the frons and two round spots on the crown black. Pronotum fuscous, with three oblong oval yellow spots on the front margin; hind margin broadly whitish. Scutellum yellow, with a large black triangle on each side of the base. Elytra whitish hyaline, a broad stripe in the clavus and another in the brachial area fuscous; second and fourth apical areas fumose. Abdomen black; hind margins of the segments very narrowly whitish. Legs whitish, claws fuscous. Length, 3 mm.

Amongst rushes and long grass in damp places; not very common. A female taken in spring at the roots of ling had the stripes on the elytra rather strongly tinged with pink.

6. *Zygina scutellaris*, H.-S.

Typhlocyba scutellaris, H.-Sch., Deuts. Ins., 164, 18; Flor, Rhyn. Liv., ii., 405, 16; J. Sahl., Not. Fenn., xii., 182, 11.

T. pullula, Boh., Sv. Ak. Handl., 45, 20 (1847).

Eupteryx scutellaris, Marsh., Ent. Mo. Mag., iii., 246, 11.

Zygina pullula, Leth., Cat. Hem. Nord., ed. ii., 75; Cicad. d'Eur. (*Typhlocybini*), 71, 5.

Z. scutellaris, Ferrari, Cicad. agri Ligust., 85.

Frons and forehead fuscous, the former with a broad yellow middle stripe on the lower half, and some traces of transverse yellow side-lines, the latter with a yellow crescent-shaped spot on each side; cheeks and temples yellow; clypeus dark fuscous or black, except at the extreme base; crown yellow. Pronotum greenish yellow in front, whitish behind; across the middle a fuscous band, which is much dilated in the middle towards the front margin. Scutellum greenish yellow, with a black triangle on each side of the base; apex narrowly black. Elytra whitish hyaline, the clavus, the costal area, and the basal half of the sub-costal area tinged with greenish yellow; nerves greenish yellow. Abdomen black; hind margins of the segments very narrowly yellow. Legs greyish yellow, claws fuscous. Length, 3 mm.

Amongst fine grasses in autumn; rather local.

Explanation of Plate III.

Fig. 1. *Evacanthus*; wing.
2. *Graphocræus*; upper fore parts.
3. *Tettigonia*; wing.
4. *Eupelix*; upper fore parts.
5. *Strongylocephalus*; upper fore parts.
6. *Acocephalus*; upper fore parts.
7. *Platymetopius*; upper fore parts.
8. *Doratura*; *a*, apex of abdomen, ♀; *b*, upper fore parts.
9. *Paramesus*; upper fore parts.
10. *Glyptocephalus*; upper fore parts.
11. *Stictocoris*; face.
12. *Athysanus*; face.
13. *Deltocephalus*; upper fore parts.
14. *Limotettix*; upper fore parts.
15. *Thamnotettix*; upper fore parts.
16. *Alebra*; wing.
17. *Dicraneura similis*; ♂ genital plates, seen from behind.
18. *Gnathodus*; upper fore parts.
19. *Dicraneura*; wing.
20. *Kybos*; *a*, elytron; *b*, wing.
21. *Allygus*; upper fore parts.
22. *Chlorita*; *a*, elytron; *b*, wing.
23. *Typhlocyba*; wing.
24. *Zygina*; *a*, elytron; *b*, wing.
25. *Eupteryx*; wing.

III. *Notes on the species of the lepidopterous genus* Euchromia, *with descriptions of new species in the collection of the British Museum.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

[Read November 2nd, 1887.]

Plate IV.

The genus *Euchromia* contains some of the most brilliantly coloured of all the tropical Burnet-moths; the greater part of the species are well represented in the National Collection, and form as beautiful a group, and as worthy of public attention, as the humming-birds in the class of Aves.

My attention has been at this time specially called to the genus by the receipt of a paper by Herr Röber of Dresden, in which four supposed new forms are described, only one of which I regret to say will be able to stand.

In my examination of the species I have been assisted by my colleague, Mr. W. F. Kirby, who has not only sent me for my use his MS. Catalogue of the genus, but has re-examined with me all species in the collection the verification of which was in any way open to doubt.

About twenty-five species have been described; I say "*about*," because two forms, *E. aruica* and *E. ganymede*, are only doubtfully distinct from *E. irius* and *E. creusa* respectively. The following is a list of the species in the Museum collection.

1. *Euchromia gemmata*, Butler. (Pl. IV., fig. 1).

One fine example only of this very distinct species, obtained by Mr. Woodford in the Solomon Islands.

2. *Euchromia rubricollis*, Walker.

Aneiteum and Mallicollo. We have a series of this species collected by Mr Gervase Matthew, and nine examples have been reserved to illustrate the species.

3. *Euchromia lurlina*, n. s.

About the size of *E. isis*; general pattern of wings as in *E. creusa*, the primaries being black with six hyaline white spots and two or three metallic blue spots, the secondaries with two spots divided by the nervures and a blue spot between them; the spots of the primaries differ from those of *E. creusa* as follows,—the pair separated by the median vein form an oblique oval; and the pair separated by the third median branch, as well as the isolated spot above them, are elongated to twice the length and therefore more nearly approach the outer margin; body black, the frons and margin of eyes snow-white, the shoulders and base of abdomen pale ochreous, the shoulders also opaline; the centre of tegulæ and metathorax metallic greenish blue; the second and third abdominal segments bordered behind with blue and with bright ochreous at the sides, the fourth segment broadly bordered with vermilion; remaining segments with extremely narrow blue edge; coxæ pearly white: body below dark brown, the fourth abdominal segment edged with ochreous. Expanse of wings, 38 mm.

One example of this very distinct species, from Thursday Island, was purchased in 1880.

4. *Euchromia isis*, Boisduval.

Of this very pretty species we only have one specimen, from Duke of York Island; it was obtained by one of the collectors for the Godeffroy Museum, and was purchased in 1882.

5. *Euchromia aruica*, Walker.

As already stated this may not be distinct from the *E. irius* of Boisduval, from which it chiefly differs in the size and width of the hyaline spots on the wings.

Two examples, Aru (*Wallace*).

6. *Euchromia æmulina*, Butler.

Allied to the preceding, though unquestionably distinct; we only possess one example, from New Guinea.

7. *Euchromia cœlipennis*, Walker.

Two examples from Amboina; it also occurs in Ceram, and has recently been described and figured by Herr Rober, under the name of *Glaucopis pagenstecheri*.

8. *Euchromia ænone*, Butler. (Pl. IV., fig. 2).

One of the most beautiful species in the genus; we have a good series collected by Messrs. Woodford and Mathew in Alu, Sta Anna, Guadalcanar and Malayta (Solomon Islands).

9. *Euchromia mathewi*, n. s. (Pl. IV., fig. 3).

Allied to the preceding; decidedly smaller, the primaries with the subbasal elongate spot and the spot above the median vein smaller; the discal patch divided into three, instead of two large spots; the basal patch of secondaries much wider, in the female uniting with the trifid patch beyond; the body is more slender than in *E. ænone*, the shoulder spots pearly white instead of ochreous, the basal segment white at the sides, anterior coxæ snow-white instead of metallic green, the metathorax with two metallic green spots placed obliquely on each side, the crimson abdominal segments completely encircling the abdomen; the black intervening stripes being narrower than above, but not interrupted. Expanse of wings, 36—41 mm.

Solomon Islands: Three examples collected by Mr. Gervase Mathew.

10. *Euchromia creusa*, Linn.

This is the species figured by Cramer under the name of *Sphinx irus*, and by Herr Röber, under the name of *Glaucopis dubia*. I believe *S. thelebus* to be a representation of a worn example of the same species (such as we have from Ceram); our series consists of two examples from Ceram, three from Gilolo, one from the Celebes, one from the Pelew Islands, and one from the N.E. coast of Australia.

Var. ? *Euchromia ganymede*, Doubleday.

This handsome form is the commonest and most variable of the group; it differs from typical *E. creusa* principally in the much greater size of the hyaline spots on its wings; the outer spots of the primaries vary from three

to four and occasionally five, the anterior coxæ are either snow-white or metallic green (in specimens from the same island); the basal segment of the abdomen is either wholly green, or has the centre black, or has the sides opaline whitish and the centre brownish orange; grades between these variations also occur, proving that they have, in this species, no specific value; the black bands across the carmine also vary in width. We have a series of twenty-one examples in the collection from Australia, Ké Island, the New Hebrides, Lizard Island, Treasury Island, Pentecost, Guadalcanar, Alu and Malayta, of the Solomon group.

To this section of the genus belongs the *Glaucopis paula* of Röber, from East Celebes, a small species apparently allied to *E. cœlipennis*, but unknown to me. It is possible that *E. cincta*, of Montrouzier, may also come into this section, but the secondaries are described as having four yellow spots upon them, an entirely new feature among the hyaline winged species.

The following are species in which the primaries and nearly the whole or sometimes the whole of the secondaries are opaque.

11. *Euchromia lethe*, Fabricius.

This is the *Sphinx eumolphus* of Cramer, and was confounded by Walker with the following very distinct species under the name of *E. sperchius*; it is a common S. African species, and we have it from Natal, the Cape, and Madagascar.

12. *Euchromia fulvida*, n. s. (Pl. IV., fig. 5).

The West African representative of the preceding, and equally common; it differs in having the pale patches on the wings deep fulvous instead of sulphur-yellow; the metallic markings less blue, and the fifth segment of the abdomen pearly greenish-white instead of metallic green like the posterior segments; the anterior coxæ metallic green instead of pure white. Expanse of wings, 45—54 mm.

Thirteen examples, from the Congo, Angola, Sierra Leone, &c., are in the Museum series.

13. *Euchromia splendens*, n. s. (Pl. IV., fig. 4).

Differs from the preceding in the blacker colouring of the wings, he absence of the metallic spots between the deep fulvous patches on primaries, the much less distinctly separated fulvous patches on the secondaries, the total absence of all orange or red colouring from the thorax; this part of the body is jet black, the head, sides of collar, tegulæ (excepting the fringes) and a dorsal longitudinal stripe brilliant greenish blue; the basal abdominal segment is more orange and the fourth segment of a deeper red than in *E. fulvida*, and all the other segments are brilliant metallic greenish blue, the second and third segments edged with black. Expanse of wings, 49—53 mm.

Old Calabar to Camaroons.

14. *Euchromia africana*, Butler.

A common African species intermediate to some extent between *E. splendens* and *E. madagascariensis*, the secondaries being like those of the former, the primaries and body more nearly resembling the latter species: we have seven examples from Natal, Zululand and Delagoa Bay.

15. *Euchromia madagascariensis*, Boisduval.

Two specimens from Madagascar. The *E. amœna* of Moeschler, said to have come from Silhet, seems nearly allied to this species. Is it positively certain that the locality is correct? Surely it would be in Mr. Moore's vast Indian collection.

16. *Euchromia leonis*, Butler.

The body of this species resembles that of *E. splendens*, the wings, however, are wholly different. We have three specimens from Sierra Leone.

17. *Euchromia sperchius*, Cramer.

This is the *E. interstans* of Walker, represented by two examples from Ashanti.

18. *Euchromia horsfieldii*, Moore.

Five specimens, collected by Dr. Horsfield in Japan, are in the Museum series.

19. *Euchromia formosana*, n. s. (Pl. IV., fig. 7).

Pattern of primaries nearly as in *E. horsfieldii;* the orange patches wider; the interno-median patch partly divided before the middle by two black dots placed obliquely; secondaries nearly as n *E. polymena*, but the basal patch smaller; body as in *E. orientalis*, the fourth to sixth segments being carmine-red. Expanse of wings, 48 mm.

Formosa (*Hobson*).

20. *Euchromia fraterna*, Butler.

A species occurring in Moulmein, of which, at present, we have only one example, but which (judging by the constancy of its allies) is almost certain to be a fixed type; Herr Rober, however, says that he agrees with Herr Snellen in regarding this and *E. celebensis* as "insignificant aberrations, unworthy of names;" after which he proceeds at once to give one of them a new name himself.

21. *Euchromia orientalis*, Butler. (Pl. IV., fig. 6).

The common Burmese representative of *E. polymena*: the type unfortunately was labelled "N. India"—doubtless an error, as the species has since come in some numbers from Burmah; though, unhappily, many of them were so much injured as to be unfit to put into the collection.

22. *Euchromia polymena*, Linneus.

We have eight examples, from India and Ceylon.

23. *Euchromia celebensis*, Butler.

Four specimens from the Celebes: this is the *Glaucopis butleri* of Rober; he says that it differs from *E. celebensis*, in having the "lower radial of the primaries broadly bordered with black"—a slightly variable but constant character of *E. celebensis*.

24. *Euchromia laura*, Butler. (Pl. IV., fig. 8).

Although we only have one example of this species, and with the vague locality "E. India," it is so well-marked that its distinctness can be considered certain.

25. *Euchromia siamensis*, Butler.

One example only, from Siam.

In one of his 'Revisions of Australian Lepidoptera,' Proc. Linn. Soc. N. S. W., 2nd ser., vol. i. p. 787 (1886), Mr. Meyrick describes what he regards as *Euchromia polymena* from North Australia. Judging by his description of the markings of the primaries, I have no hesitation in pronouncing it to be perfectly distinct from the Indian species. As, however, I have not seen the broken specimen from which Mr. Meyrick penned his description, I leave it to him to give it a distinctive name: it probably should stand near the following.

26. *Euchromia semiluna*, Walker.

A very distinct species founded upon a single example, the habitat of which is unknown.

Explanation of Plate IV.

Fig. 1. *Euchromia gemmata.*
2. " *œnone.*
3. " *mathewi.*
4. " *splendens.*
5. " *fulvida.*
6. " *orientalis.*
7. " *formosana.*
8. " *laura.*

IV. *Descriptions of some new species of* Lepidoptera *from Algeria.* By George T. Baker, F.L.S.

[Read December 7th, 1887.]

Early in the present year I received from my correspondent, Herr Pech, of Budapest, another interesting collection of Lepidoptera, which he had taken in the neighbourhood of Sebdou, prov. Oran, Algeria. He remained there about four months—from March to July—and captured, among other good insects, a few new species, which I am now describing :—

Ino Orana, n. s.

Alis anticis, capite, thorace, abdomineque cæruleis. Alis posticis supra infraque nigrescentibus, infra ad basim cæruleo tinctis. Antennis cæruleis non elongatis, breviter pectinatis, dentibus fuscis; femoribus cæruleis, tibiis tarsisque fuscis.

The anterior wings are of a lustrous bluish bronze, with brownish fringes. The posterior wings are sooty grey, with brownish fringes. The antennæ are short, with short pectinations right up to the tip, which is abruptly and bluntly terminated; they are moderately stout, bluish in colour, with brown pectinations. The head, thorax, and abdomen are of the same hue as the anterior wings, but slightly greener. The femora are blue, and the tibiæ and tarsi brown. Length, 18 to 19 mm.

I have four males, all from Sebdou. Its nearest ally is apparently *Dolosa*, Stgr. (*vide* Stett. Ent. Zeit. Jahr., 48, p. 49), but, not having a specimen of this *Ino* before me, I am unable to give the specific differences. From the Amoor species *Tristis*, Brem., my insect can be easily recognised by its smaller size and blue lustre, by its shorter antennæ, by the pectinations being decidedly shorter, and by the tip being bluntly terminated.

From *Cirtana*, Luc., its nearest Algerian ally, it may at once be separated by its blue lustre and rather larger size (*Orana* being a robust little species with wider

wings); also by the antennæ being bluntly terminated, with the pectinations decidedly shorter.

Zygæna Oberthüri, n. s.

Corpus nigrum, thorax niger, collum albidum. Caput antennæque violaceo-nigræ. Alæ anticæ nigrescentes, maculis quatuor anterioribus confluentibus minio-rubris, margine flavo-albido; macula quinta posteriore reniformi rubra, margine flavo-albido, ciliis cinereo-fuscis. Alæ posticæ minio-rubræ margine nigro; ciliis fuscis. Femora nigra, tibiæ tarsique, cinereo-fusci.

The anterior wings are of a blackish colour, with a faint bronze lustre. All the spots, except the posterior one, are confluent and of a vermilion hue, narrowly edged posteriorly and interiorly with cream-colour; in one specimen this cream border encircles the far red spot by the costa; the posterior vermilion spot, also encircled with cream, is kidney-shaped, placed close to the hind margin, with its long axis parallel thereto; the dark ground colour extends along the inner margin narrowly in the female, but wider in the male. The costa of male is edged by a narrow black line, whereas that of the female is edged by an extremely fine line of a creamish hue. The fringes are of a brownish cream-colour. The hind wings are vermilion, bordered with black rather broadly at the apex, but narrower towards the anal angle. Fringes brownish. The head and abdomen are bluish black; the thorax is also bluish black, with a whitish collar in both sexes. The femora are black, but the tibiæ and tarsi are greyish. Length, 23 to 24 mm.

Two specimens of this very pretty *Zygæna* were taken at Sebdou, both of which are in my collection. At present the species will stand in a somewhat isolated position, as, owing to the confluence of the spots, at least three-quarters of the fore wings are of a vermilion-colour, this feature separating it from any Palearctic *Zygæna*.

I dedicate this fine insect to Mons. C. Oberthür, who has added so much to our knowledge of the Algerian fauna.

Acidalia Algeriensis, n. s.

Alæ anticæ pallide ochreo-cinereæ, puncto centrali nigro, linea juxta basim fusca, linea media indistincta, lineis binis posterioribus undulatis cinereo-fuscis, margine posteriore late obscuriore punctis nigrescentibus; ciliis cinereis. Alæ posticæ pallide ochreo-cinereæ, linea media, puncto nigro centrali ad marginem interiorem distinctissima, lineis binis posterioribus distinctis margine

posteriore late griseo-fusca, sed fimbria angusta pallida punctis nigrescentibus; ciliis cinereis.

The anterior wings are of a greyish buff; the first transverse line near the base fairly distinct and of a greyish brown colour; the second transverse line immediately behind the dark central spot is almost obliterated. The two posterior transverse lines, placed close together, are moderately distinct, and of a greyish brown hue. The hind margin is bordered rather broadly with greyish brown, and is finely and darkly dotted. The posterior wings are of the same colour as the anterior wings; the middle transverse line is very distinct from the dark central spot to the inner margin, but is scarcely perceptible from the spot to the upper margin; the two posterior wavy transverse lines form a continuation of the similar markings in the fore wings. The posterior margin is broadly bordered with greyish brown, but is edged at the extreme border very narrowly with paler grey; this posterior margin is also darkly and finely dotted. Fringes same hue as the wings. Body and thorax slightly darker than the wings. Length, 16 mm.

One male specimen of this obscure little *Acidalia* was taken at Sebdou, and is in my collection.

Pleurota Staintoniella, n. s.

Alæ anticæ cinereo-fuscæ, vittis duabus (costali et centrali) argenteo-albidis, apice subacuminato ♂, acuminato ♀. Alæ posticæ fusco-cinereæ, ciliis pallidioribus. Palpi capite et thorace longiores, cinereo-albidi irrorati punctis parvis cinereo-fuscis.

♂. Anterior wings greyish brown, occasionally inclining to tawny, with the costal and central stripes white, slightly silvery, the former extending nearly to the apex, the latter up to the hind margin just below the apex; both stripes are rather narrow, the central one attenuating as it approaches the posterior margin. The fringes are of a greyer hue than the wings, which latter are very slightly acuminate. The hind wings are dark sooty grey, with slightly paler fringes. Head, palpi, and thorax grey; the palpi are thickly irrorated with dark fuscous, and are rather longer than the head and thorax, the end joint being about the length of the head. Length, 22 to 24 mm.

♀. Anterior wings grey or ochreous grey, thickly irrorated with darker scales, with the costal and central stripe more silvery and broader, the latter extending right through the fringes, which are whitish, and the apex is acuminate. The hind wings are paler,

with greyish fringes. Head and palpi whitish, dusted beneath with blackish minute irrorations. Length, 24½ mm.

This *Pleurota* will follow *Macrosella*, from which it differs by its smaller size and its darker and greyer hue. It is also a rougher-looking insect, having the appearance of being thickly covered with coarse grêyish scales.

Six males and two females were taken at Sebdou, all of which are in my collection; they differ slightly *inter se*, some specimens being paler than others. I have (with his kind permission) dedicated this *Pleurota* to Mr. Stainton, who is so well known in connection with Micro-Lepidoptera.

Pleurota Mauretanica, n. s.

Alæ anticæ ochraceo-fuscæ, margine interiore pallidiore, vittis duabus (costali et centrali) argenteo-albidis. Alæ posticæ cinereæ. Palpi, capite et thorace longiores.

The anterior wings are of a warm brown colour, with a slight chestnut tinge. The costal stripe, extending almost to the apex, is silvery white; the central stripe, also silvery white, is of moderate width, and extends right up to the hind margin; it is of uniform width for about two-thirds of its length, when it narrows suddenly for the remaining third, but does not produce a tooth. Fringes greyish white. The posterior wings are dusky grey, with paler fringes. Head, palpi, and thorax whitish, dusted with grey. The palpi are thickly dusted beneath with dark grey, and are slightly longer than the head and thorax. Length, ♂ 24, ♀ 22 mm.

One pair were taken at Sebdou, which are in my collection. The species should be placed between *Schlægeriella* and *Algeriella*; from the former it may be recognised by its larger size, its broader and more silvery costal and central stripes, and by its richer and glossier colour. From *Algeriella* it may be distinguished by its darker colour, by its central stripe being narrower, less silvery, and not toothed on the fold; and in the female the costa of the anterior wings is decidedly straighter and the apex less acuminate than in that species.

Pleurota Oranella, n. s.

Alæ anticæ ochraceo-cinereæ vittis duabus costali et centrali margaritaceis, centrali in medio furcata ramo superiore recto prope ad apicem inferiore ad angulum analem currente, ciliis margaritaceis. Alæ posticæ subhyalinæ cinereæ; ciliis coloris ejusdem.

The posterior wings are of a greyish ochre, with the pearly white costal stripe of moderate and uniform width extending right up to the apex, where it joins the long white fringes, and gives the wing the appearance of being bordered with white along the costa and posterior margin. The central stripe, also pearly white, extends nearly up to the hind margin; this stripe is widest about the centre, where it emits a branch along the fold, forming a fork right up to the inner angle; the upper branch widens somewhat beyond the division, and then tapers slightly to its extremity. The inner margin is pearly white at the base. The apex is not acuminate in either sex. The hind wings are glossy greyish white, of a semitransparent hue, with paler fringes. The palpi are shorter than the head and thorax, and are recurved over the face in a manner very unlike the erect oblique position usual to the genus. Length, ♂ 22 to 24, ♀ 26 mm.

Ten males and one female were captured at Sebdou, all of which are in my collection. The species is very nearly allied to *Honorella*, but may readily be separated from that species by its forked stripe being broader, longer, and very much less silvery; its anterior wings are darker and greyer, whilst the hind wings are paler than in *Honorella*. The palpi are also shorter than in that species,

From *Galaticella* it may at once be distinguished by the fold-streak, which forms little more than a tooth in that insect; whereas in mine it makes a long fork right up to the inner angle. The colour is decidedly paler and greyer than in *Galaticella*, and this latter insect has no white margin at the base of the inner edge of the anterior wings.

Thalpocares Respersa, var. *Bythinica*.

This is a very beautiful variety of *Respersa*, in which nearly all the upper surface of the anterior wings is suffused, more or less intensely, with rosy mauve, all the usual brown markings being almost obliterated and replaced by a shade of the rosy colour; the triangular apical patch is pinkish brown instead of the usual darker hue. The posterior wings are almost unicolorous, but rather paler towards the base; there is, however, the usual lighter transverse line near the posterior margin. The variety is rather larger than the parent species.

Two specimens were taken at Brussa, in Asia Minor, one of which is in my collection.

V. *Report of Progress in Pedigree Moth-breeding to Dec. 7th,* 1887, *with observations on some incidental points.* By FREDERIC MERRIFIELD, F.E.S.

[Read December 7th, 1887.]

PLATE V.

IT will rest with Mr. Francis Galton to describe at the proper time and place the results of the experiments in pedigree moth-breeding which I have commenced for him, if they should be carried to a successful conclusion; but in the meantime I am encouraged by him to write a sort of report of the progress hitherto made, and I think it is possible that the facts already observed may throw light on some points that are frequently subjects of inquiry and discussion in entomological and other periodicals. There are many of these points on which I have noted facts that may hereafter prove useful; but there are not many on which the observations made have been carried far enough to justify me in occupying the Society with them, and as to these I bring them forward partly in the hope of receiving suggestions from investigators qualified to offer them by scientific training and a lengthened experience, to neither of which I have any claim.

Having obtained an abundant supply of *S. illunaria* (*bilunaria* of the 'Entomologist' list) much earlier than of *S. illustraria* (*tetralunaria* of that list), I was led to try more experiments with the former than I had at first intended. I determined, in particular, to try the effect of forcing, partly in the hope that if success attended these efforts the period necessary to obtain pedigree results would be much shortened, and partly because I thought it would be interesting to know the effect that would be produced by forcing a rapid succession of short generations on an insect which in the natural state has in temperate climates only two generations, one covering four or five months mostly warm, the other seven or eight months mostly cold, each of these naturally alternating broods presenting such differences in size,

colour, depth of hue, and, it is alleged, form, that until one was bred from the other the two were considered distinct species.

In describing my experience with the several groups successively experimented on I begin with those brought up under conditions most nearly resembling natural ones, as they will afford a convenient standard of comparison with such as were reared under more artificial circumstances. I therefore commence with those *illunaria* which were "sleeved" on growing trees. I am inclined to think that—except in the favourable circumstance that they were more effectually protected from enemies—the sleeved larvæ differed so little in their surroundings from wild-bred ones that they may be taken as fairly representative of the latter. I should, however, mention that there was one period of their lives during which nearly all the sleeved insects were subjected to a higher temperature than the natural one. In order to bring the moths out as closely together in point of time as possible, when the first moth appeared, the remaining pupæ were at once put into the forcing-box. I am not sure that this was necessary, especially with the summer brood of moths, for my experiments lead me to think that healthy individuals of this species, if kept in the dark, will live for ten days and more in summer, and for two or three weeks or more in colder weather, without any impairment of their functions, and only in rare instances will flutter so as to damage the tips of their wings enough to prevent convenient measurement.

Some preliminary explanations are necessary as to general treatment, and as to the sense in which I have used various expressions. My reason for being a little particular in these explanations is that any value such experiments as I am describing may possess depends entirely on a knowledge of the conditions under which they were tried. I have not knowingly burdened the narration with any statements, except such as seem to have some bearing or possible bearing on the results obtained. By "eggs," unless otherwise specified, I mean *fertile* eggs; and by the expression "fertile," as applied to the Selenias, I mean such as turn red, though many that go through the red stage and even the black one, which indicates that the young dark-skinned larva has been fully formed, often fail to hatch. As to the expressions

"larval" and "pupal" periods, I must explain that I found it impossible to observe, except on a few occasions, the actual date of pupation which, barring accidents, takes place inside a leaf carefully sewn together. But with the daily or almost daily, however brief, observation I was able to give, it was easy to see pretty well when a larva began to spin up, and consequently I have taken that time as the dividing line between the larval and the pupal periods. I found on several occasions, when the pupal period as thus defined lasted but eight or nine days, the larva remained in an unchanged condition for two days and more.

In my record I have found it expedient to note the period when "nearly all" had, as larvæ, spun up (*i. e.*, begun so to do), or, as moths, had emerged, because some 4 or 5 per cent., more or less, generally lagged behind the rest, from weakness of constitution I rather think. Excluding these laggards, I think the largest individuals of a brood were mostly to be found among or in point of time near to those that were longest in feeding up, and consequently in emerging. About 5 per cent. of the loss in my larvæ after I had first counted them after hatching may, I think, be ascribed to casualties, such as being squeezed or snipped or accidentally lost.

The pupæ were in all cases taken out of their cocoons and placed each in a separate chip box covered with black net, which was held in position by the rim of the lid, from which its top had previously been removed. These boxes stood on wire trays in crates and as the moths emerged were moved to crates kept dark by zinc covers standing in the cool room described later, near the window, almost always kept open, the sexes being in separate crates. I generally found the moths, especially *illunaria,* "out" when I came into the room in which they were kept, about 7.30 or 8 a.m., but some, perhaps 20 to 40 per cent., would come out during the day, rarely after 5 p.m. There is a very great difference between *illunaria* and *illustraria* in the resting position. The former rests with wings folded closely together over its back, as butterflies do. *Illustraria,* on the other hand, rests with the anterior edges of its fore wings at an angle of 60° or so to each other, the wings being all very much curved and the folds in them very wavy, and the abdomen brought into line with them, so that the insect has

somewhat the appearance of a curled leaf with the concave side upwards. It would be interesting to know the position in which the other English species of the genus, viz., *S. lunaria*, rests. At first I fed the moths from little pieces of sponge dipped in very thin syrup, but I gave this up, as it seemed to promote mouldiness, and I do not think the moths lived any the longer for it. I never saw them feed, but had little time for watching them.

When "nearly all" the moths had emerged they were measured on their under sides, the wings being folded together over their backs. The length of the fore wing was measured from its tip or extreme anterior point (B in Mr. Galton's figure, *ante*, p. 22). The other or shoulder extremity is not so easily ascertained or described, and at first the search for it gave me some difficulty; but after a certain amount of practice I found that when a strong light fell obliquely along the wing in the direction from the tip towards the shoulder, it brought out a little dark transverse crease, in some cases shortened almost to a point, between the root of the hind wing (which, viewed from the under side, of course overlies the fore wing) and the body, and this crease I made my other terminus, taking the precaution of always laying the insect to be measured in the same position. This was done by fastening on the surface of a sheet of cork two strips of the same at about five-eighths of an inch apart, so as to leave a shallow flat groove of that width between them, and laying the moth on its side in this groove, a thin wedge of wood sheathed with zinc being pushed along the groove so as to support the wings, especially their outer edges, and the wings being held down with the usual cork setting-bristle. A pair of screw-compasses was then taken, one leg fixed on the zinc at the tip of the fore wing that lies uppermost, the other leg adjusted to the crease by turning the screw, and the length was marked off on a millimetre scale. The habit of the Selenias to bend their wings backwards when at rest facilitated the task, but I found chloroform indispensable; applied in the form of vapour by a few drops on blotting-paper under a bell-glass just long enough to produce insensibility, it did not seem to hurt the insects in any way. The use of a pair of spectacles strong enough to bring my eyes to see clearly at five or six inches distance from the object was sufficient to enable

me, as I judge, to *estimate* differences amounting to the tenth of a millimetre, and I do not think all sources of error taken together would much exceed a quarter of a millimetre. It was not, however, until after I measured my sleeved *illunaria* on the 22nd July that I attained to this amount of accuracy, and therefore my earlier measurements must be taken as only approximate; but I think the *general* results are not far wrong. I should add that the "crease" cannot always be found, especially where the moth is very hairy; experience will tell the observer where it should be, and if the same person always measures, not much addition need be made to the percentage of error on account of the absence of the "crease." All measurements are of one wing only, so that the "expansion of wings" would be double the measurement given, plus about 3·5 mm. for the width of the body between the wings at the point measured. The "expansion of wings," however, measured from tip to tip of a moth set in the English fashion, would be about 1 mm. less than double the expansion of the single wing, owing to the inclination downwards and forwards.

After the moths had been measured, they were paired off in cylindrical muslin bags kept open by wire frames, each about 8 or 9 inches by 5; these bags, except where otherwise stated, were kept on a shelf outside the window of a cool room facing W.N.W., and protected from heavy rain; and there the moths laid their eggs, generally scattered over the muslin, and preferably in folds. I gave up inserting sprigs of the food-plant, as I found they rarely took any notice of them. The eggs, which will bear rough handling, were detached by hand or by the back of a knife, &c.

Nearly all the facts recorded are from my own personal observation, as I did not leave home for more than three or four days at a time, except during the last ten days of September and less than a week at the end of October, and on these occasions I had an efficient *locum tenens*, who had acted as my assistant at other times.

I have a more or less full record in most cases of the number of eggs laid, the number hatched, the number of moths that pupated and of moths of each sex that emerged, with dates and measurements, all of which may be useful for reference before the experiments are brought to a close, and which will, I hope, be dealt with by

Mr. Galton, so far as they bear on his studies in heredity. In this paper I propose only to give a *résumé* of facts observed in the different broods, for the information of those who are interested in investigations of this nature. All the moths have been preserved, and are labelled, and I have brought with me some specimens of the various broods. It will be seen that in the case of the forced *illunaria* I have had to do with as many as five successive generations in the year. In speaking of a "generation" or "brood" I reckon it as beginning with the egg; in this sense I have had to do with the first generation only in its latest, winged, stage. It is proper to remember that the succession of broods would have been still more rapid than it has been had I paired off the moths as soon as I had a couple; the delay necessary for making a selection added about a week of time. I have had actual experience of the following periods—egg 7 days, larva 16 and pupa 8 days, pairing and laying 2 days, total 33 days; and I am satisfied that it would be possible to run a generation through from egg to egg in 35 days.

I exhibit a diagram,* which will be a guide to the observations that follow, and will save much detailed description. It shows the connection of all the broods reared, and marks the extreme duration of life in the egg, larva, and pupa, and the duration of life in the moths from the time that the first appeared until the selection was made for breeding from. The moths so selected generally lived from 7 to 14 days; the others were killed and preserved.

THE EXPERIMENTS WITH S. ILLUNARIA.—The spring of 1887 was, as all will remember, a singularly cold and backward one. No *illunaria* were taken for me till 12th April. I bred from two females taken near Brighton on the 29th April and 2nd May respectively by Mr. A. C. Vine, who kindly gave them to me, and from two females taken on the 2nd May in the New Forest by Mr. Charles Gulliver, of Brockenhurst. They laid from 48 to 133 eggs each. Some of the eggs laid by them were used for preliminary trials. There were 271 left. I divided each of the four batches into three, and, mixing together one-third from each batch, obtained three lots of 90, 90,

* See Plate V.

and 91 eggs for sleeving, bottling, and forcing respectively.

SLEEVED ILLUNARIA.—*Preliminary.* — The eggs were placed in sleeves on young birch-trees not exceeding three feet in height. Though the trees were only planted last December they were in so good a condition for moving, and were so carefully removed, that the summer foliage seemed scarcely checked by the operation. My back garden, in which they were planted, is a cool one, shaded by a tall house on the E.S.E., and by a wall of five to six feet along the S.S.W. side, and the trees were mostly planted very near this wall. At midsummer they received no sunlight except between 10.30 and 1.30, and during most of this interval it was partial. These retarding conditions were perhaps somewhat counteracted by the protection afforded by the sleeve from wind and from all but heavy rain. The sleeves were made of "Victoria lawn," kept from collapsing by three split cane-rings sewn in. There can be no doubt that sleeving is the least troublesome way of feeding larvæ that require no earth; the only trouble I have found is in shifting them while young from one sleeve to another, but any loss in the process was prevented by spreading a slit newspaper on the ground below. My provision of growing leaves being small, I frequently supplemented it with fresh-cut twigs of birch, willow, or occasionally rose, dropped into the sleeve. Both *illunaria* and *illustraria* are very accommodating feeders; they will eat most forest-trees and shrubs, including brambles, and will also eat evergreen honeysuckle (*L. brachypoda*), the variegated Japan honeysuckle, and the small-leaved evergreen *Cotoneaster*; and three or four out of a score survived a diet of ivy. Mine seemed to prefer willow to everything else. When autumn came they appeared to like the leaves that were beginning to turn yellow as much as those that were still quite green. In the autumn my supply of growing foliage became exhausted, and, when the larvæ had mostly entered on their last skins, I moved them into breeding-cages: these had glass tops and ends, and finely perforated zinc sides, and the food in them stood in bottles of water. Little as the ventilation was I found that in the dry weather, of which we had so much

last summer and autumn, the food in them dried up very rapidly, and I provided the sides with coverings of varnished paper. The effect of these was that water usually stood in drops about the glass inside and sometimes ran down the sides, but the larvæ seemed none the worse for this. The dwarf sleeved trees were protected from birds, &c., by a cylinder of ¾-in. wire-netting, with a hinged top of the same, and from slugs by an outer ring made of a strip of perforated zinc 6 in. wide, any slugs within the ring being caught by greased cabbage-leaves. When my first sleeved brood was reared I put the eggs in the sleeve to hatch, but I afterwards adopted the plan of hatching them indoors, and putting the young larvæ in the sleeve when a few days old. I judged it best not to crowd together young larvæ of different ages; I am not sure the larger ones do not under such circumstances sometimes eat the little ones. By the time they have changed their second skins no naturally solitary larvæ can be more tolerant towards one another. Having made these explanations, I will shortly describe what happened to each successive brood, referring also to the tabular statement appended.

Second generation (first summer brood).—From the 90 eggs I reared 34 male and 23 female moths, together 57, none of them being cripples. The eggs were rather more than three weeks hatching; the larval period averaged 38 days; the pupal period of the first moth that emerged was 13 days. The pupæ were forced from the time the first moth appeared—15th July—and the last came out 25th July. May and the early part of June were very cold and dry. I paired off 9 couples, 7 of which laid fertile eggs. I bred from the largest pair (A) a medium-sized pair (M) and the smallest pair (Z).

Third generation (A 1, M 1, Z 1).—These eggs hatched in 7 or 8 days; the larvæ averaged 50 to 60 days in feeding up. I have obtained from them the following pupæ, now passing the winter out-of-doors, of A 1, 101; of M 1, 64; of Z 1, 60. As the sleeved food was in danger of falling short, on the 13th September, when a few were beginning to spin up, I transferred the larvæ from the sleeves to breeding-cages; and on the 15th October these breeding-cages were brought indoors to hurry on the remaining larvæ before their food-supply should fail. All were in pupa by the 25th October.

Bottled Illunaria.—*Second generation.*—These were brought up on cut food in Bordeaux plum bottles, covered with muslin, plate-glass being laid over the top and slid away when the moisture inside the glass was excessive. The 90 eggs were three weeks in hatching; the larval period averaged 30 or 31 days, the pupal 14 days. I bred 31 males and 32 females, together 63; no cripples. They were distinctly larger than the sleeved ones. When the larvæ were about half-grown (on 18th June) I transferred half of them to an outdoor breeding-cage. The only difference I found in the moths so treated was that they were about two days later, and were smaller, *viz.*, the male averaged 17·60 instead of 17·70, the females 19·00 instead of 19·50. The weather was so warm most of the time that there could have been little difference in *temperature* between the two batches; but it was very *dry* weather out-of-doors, while in the bottles a moist atmosphere prevailed. I did not think it necessary to continue this brood.

Forced Illunaria.—*Preliminary.*—The forcing boxes were two, their inside dimensions about 2′ 4″ by 1′ 8″, and 2′ in depth. They were of wood, with glazed lids set on a slight inclination forwards, and ventilation capable of being closed, and were warmed at the bottom by a zinc cistern, under which was a gas-jet. One had glass also in front and partially at the ends. The temperature was generally from 70° to 80° Fahr., but occasionally (more especially when the sun shone into the room in the afternoon) it rose to 90°, and sometimes at night it fell to 60°. In the summer it was generally some 15° higher than the air of the room. Until the larvæ were about half-grown, and sometimes till they had spun up, the forced larvæ were brought up on cut food in bottles, or else in glass cylinders having a sloping sheet of muslin at the bottom, with a hole in it for the neck of a bottle containing food. When half-grown they were generally transferred to breeding-cages placed in the forcing-box; in both cases the atmosphere was quite a moist one. The forcing did not begin till 28th May, when the eggs laid by the wild-bred moths were on the point of hatching.

Second generation.—From the 91 eggs I reared 25 male and 33 female moths, together 58; no cripples.

The hatching (not forced) lasted about 3 weeks, the larval period 18 or 20 days, the pupal 8 or 10 days. The moths were larger than the sleeved ones, but not so large as those that were bottled. On 3rd July I paired off two of the largest (A), 5 of medium size (M), and 2 of the smallest size (Z); and from all of these, except one M and one Z, I had fertile eggs, which I bred from as follows:—

Third generation (eggs not placed in the forcing-box till earliest of them about to hatch).—The 3 broods did not vary much in their rate of progress—the M's were 2 or 3 days behind the A's, the Z's 2 or 3 days later still: the larval and pupal periods together were about the same as in the second generation. From 205 A 1 eggs I bred 68 male and 61 female moths, together 129, six cripples; from 115 M 1 eggs, 35 males and 53 females, together 88, one cripple; from 107 Z 1 eggs, 16 male and 14 female moths, together 30, 3 of them cripples, and two so weakly that they died before they could be paired: many of the Z 1's died as larvæ. The A 1's comprised the largest I had yet bred; I did not average them: the M 1's (averaged by taking every alternate one of each sex in the order of emergence) were slightly larger than the average of the preceding generation: the Z 1's considerably smaller. I paired off 4 of the largest couples among the A's, 4 average couples of the M's, and 10 couples of the Z's. None of the A's or Z's laid a fertile egg: 3 out of the 4 M's laid fertile eggs, and from one of these pairs, paired 16th August, I had 210 eggs, which I bred from as follows:—

Fourth generation, M 2.—These were not only slower, but straggled more in their feeding up and emergence than the earlier forced generations had done. The first spun up 23rd September; by 8th October nearly half had done so; and on the 1st November all had done so except two, which soon after died. Many larvæ died in pupating, and a few before. I have some reason to think this was owing to their having been made too hot at one time. The first moth appeared 2nd October; by the 3rd November 60 were out, and on the 7th the last appeared; but 3 or 4 are still in pupa, one or two of them certainly being alive. 36 are males and 25 females; 3 were cripples, and 3 more died before they were paired off. The hatching occupied about 10 days

(eggs not in the forcing-box till the first eggs were about to hatch), the larval period ranged from 26 to about 59 days; the pupal period seems to have been about 12 days. After the early alarm they were kept rather cooler than the preceding forced generation had been, as, with the advent of cooler weather, I found it difficult to keep up a high temperature without making the bottom of the forcing-box very hot. The average size had again risen on that of the preceding generation. On 23rd October I paired off 6 couples, keeping them in the forcing-box, and 4 of them were fertile. The largest pair laid 170 eggs (called M 2, A 1), the medium-sized 210 (called M 3), the smallest 80 (called M 2, Z 1).

Fifth generation.—About 86 of the first, 169 of the second, and only 24 of the third hatched. The numbers are now about 82, 151, and 21 respectively. I am feeding them up on rose and evergreen honeysuckle, and the most forward are nearly full-grown, as will be seen by the living specimens I exhibit. I have made an improvement in my forcing-box, so that I can keep up a more equable temperature without danger of roasting those which are near the cistern, and I keep it at about 70° to 80°.

ILLUNARIA.—*General results.*—Without venturing any opinion on many of the questions suggested by an examination of the facts above detailed, until more facts have been accumulated, I may advert to a few of them. It seems to be established that *S. illunaria* forces well, and there is evidence that the average size of forced specimens is larger than that of the insects reared on growing trees, and tends for a time to increase from generation to generation, notwithstanding close interbreeding. I am not satisfied that the fertility has been diminished by the process of forcing; but it does at present appear as if extremes in size, especially in the direction of smallness, have a tendency to be sterile, and I think it prudent to select the breeding pairs from some point quite short of either extremity in the scale of size. There is another fact established as to the summer broods of *illunaria*,—all of which that I have reared, I need hardly say, are in appearance of the summer type, *Juliaria*,—*viz.*, that, in accordance with the usual rule with the *Geometræ* inhabiting this

country, the female on the average is larger than the male, and decidedly so. This will appear clearly by the tabular statement I refer to. My own personal experience, which is confirmed by trustworthy information I have lately received from several quarters, is that in the spring brood the case is reversed, so that the male is decidedly the larger; at all events, it seems certain that the spring female has no excess of size approaching to what she shows in the summer brood. In this connection I venture to call attention to the following points :—(1), of 272 *Geometræ* described in Stainton's 'Manual,' only 16 are recorded as appearing in the five months from November to March; (2), *illunaria* in its spring emergence is one of them; (3), of the remaining 15, 9 have apterous or quasi-apterous females (there being only two other apterous females among the 272, and these two appear in April and October respectively); (4), another of the 15 (*H. pennaria*) has the wings of the female strikingly smaller than those of the male. Is it possible that the relative size of the female in the spring emergence of *illunaria* is a step towards the condition of apterousness, or, it may be, a remnant of it? So far as I have had means of judging, *illustraria* and *lunaria* do not show such a difference between the sexes according to the season of emergence, but their spring broods are much later than those of *illunaria*, which (unless *Tephrosia laricaria* (*biundularia*), another of the 16, of which I know but little, resembles it in this respect), is unique among double-brooded English *Geometræ* in producing its early brood in a winter month.

S. ILLUSTRARIA.—Mr. Barrett kindly sent me eggs from a female taken in Norfolk in May, and Mr. Gulliver, of Brockenhurst, supplied me with some larvæ beaten in the New Forest. From these two sources I bred 9 males and 12 females, and, though the variety in size was not very great, I selected a large (A), medium (M), and small (Z) pair, the eggs from which I sleeved; and from them I have three batches of hybernating pupæ, *viz.*, A 116, M 103, and Z 78. I reared several mixed broods in the forcing-box, with some remarkable results, which I hope to follow up.

Concluding Remarks.—I shall be very glad if the account I have given of the experiments with the Selenias, and of the ease with which they can be bred, should lead others better qualified than I am to take up the subject; and I shall be glad to supply eggs of any race bred. The remarkable changes which the larvæ undergo in appearance, attitude, and habits, so well described by Mr Poulton; the perfection to which the imitation of jagged twigs has been developed in them; the great variation in size of individual moths, especially in the spring brood, and in shape; the richness and variableness of shading and colour in the wings, and their unusual positions when at rest, apart from other points to which I have already called attention, make them a very remarkable group, and they ought to have an interesting family history. The experiments I am trying with *illunaria* and *illustraria* will leave abundant scope for other investigators who may direct their attention to these two species, and a very interesting species, *S. lunaria*, remains. *Tephrosia laricaria*, which is stated to resemble *illunaria* in having an early spring and summer emergence, and in the smaller size and different appearance of the latter brood, would also be an interesting species to work up. As to *illunaria* and *illustraria*, may I suggest that practical entomologists would be promoting the investigation by preserving any specimens they may meet with next spring, or a fair sample of them, for comparison with the numbers I expect to bred? I should be particularly obliged by being afforded any opportunity of seeing, and, if judged expedient, breeding from, specimens of either species from Scotland or Scandinavia, where they are stated to be single-brooded, or from Ireland, Wales, or Central or Southern Europe.

[*Note as to Measurement.*—I find it is practicable, without piercing the insect, to measure the *expansion* of wings of the chloroformed insect by setting it temporarily, with cork setting-bristles, on a *flat* setting-board covered with paper ruled in square millemetres, and after trial I recommend this mode decidedly as the more safe and certain in its results. The tips of the fore wings should be as widely separated as possible, so that the front edges of these wings will be nearly in a straight line.]

TABULAR STATEMENT OF FERTILE EGGS LAID, AND MOTHS REARED, WITH MEASUREMENTS.

Eggs.	MOTHS.						Larval & pupal period. Days.
			Largest.	Smallest.	Diff.	Average.	
		First Generation. Wild.					
	♂	1				20·20*	
	♀	4	22·40	18·10	4·30	20·20	
						0·0	
		Second Generation. Sleeved.					
	♂	34	18·70	16·70	2·00	17·35	
	♀	23	20·30	16·30	4·00	18·24	
90		57	1·60	·40		·89	51
		Bottled.					
	♂	31	18·70	16·60	2·10	17·65	
	♀	32	20·70	18·10	2·60	19·26	
90		63	2·00	1·50		1·61	45
		Forced.					
	♂	25	19·00	15 90	3·10	17·54	
	♀	33	20·80	17·90	2 90	18·95	
91		58	1·80	2·00		1·41	30
		Third Generation. Forced. A 1.					
	♂	68	19·60				
	♀	61	21·10				
228		129	1·50				30
		Forced. M 1.					
	♂	35				17·88	
	♀	53				19·20	
115		88				1·32	32
		Forced. Z 1.					
	♂	16	16·90	15·40	1·50	16·15	
	♀	14	18·30	15 60	2·70	17·57	
107		30	1·40	·20		1·42	34
		Fourth Generation. Forced. M 2.					
	♂	35	19·80	17·00	2.80	18·41	
	♀	26	20·90	18·20	2·70	19·40	
210		61	1·10	1·20		·99	52

* Average of five males taken in spring, 21·50; of five females then taken, 19·90; difference in favour of male, 1·60. In all the later generations the difference is ·89 to 1·61 in favour of female.

Explanation of Plate V.

The explanation of this Plate will be found at p. 128.

VI. *Life-histories of* Rhopalocera *from the Australian region.* By Gervase F. Mathew, Staff-Paymaster, R.N., F.L.S., F.Z.S., &c.

[Read December 7th, 1887.]

Plate VI.

During a period of more than three years spent in cruising off the coasts of Australia and New Zealand, and amongst the islands of the Western Pacific, I devoted as much of my leisure time as I was able to in collecting Lepidoptera, and working out, to the best of my ability, the life-histories of such Rhopalocera as it was my good fortune to obtain the larvæ of. In doing this there were many obstacles to contend with, such as the constant change of locality, the shortness of our stay at the different places visited, and the difficulty of preserving fresh, for any length of time, the various food-plants for the sustenance of the larvæ.

For many years I have taken the liveliest interest in rearing Lepidoptera from the egg or larva, and noting the habits of the different species in a state of nature, and have often regretted, when perusing descriptive works on exotic butterflies, that so little has been written concerning their earlier stages, or so little said as to the general habits, localities, times of appearance, &c., of the species described. If, when practicable, such information were furnished, the books would be infinitely more valuable; and would, I feel convinced, tend to attract many more to the study of these charming creatures.

Melanitis leda, Linn.

In Australia, I have met with this species at Cooktown, Brisbane, and Thursday Island, and Mr. Masters informs me that he has taken it near Sydney. It probably occurs, in suitable places, in all tropical parts of Australia. In the Western Pacific I observed it at Fiji,

Samoa, the Friendly Islands, New Hebrides, New Caledonia, Solomon Islands, Duke of York Islands, New Britain, New Guinea, Pelew Islands, and the Caroline Islands. They vary considerably in size and markings from the different localities, but not sufficiently to form new species, except those from Ponapé, in the Caroline Islands, which are much smaller and much darker, and should perhaps be considered a distinct race.

My observations upon the habits and life-history of this butterfly were made chiefly in Fiji, where it was very abundant. It was principally to be found in shady spots in the forest, particularly by the sides of pathways where there was plenty of coarse grass, or by the edges of clearings where sugar had been planted. It has an uncertain, jerky, manner of flight, rising suddenly from under one's feet, flying for a short distance, and pitching abruptly, usually selecting a spot covered with dead leaves, where, with it wings closed over its back, it defies detection, as the colourings and markings of the underside harmonise so completely with its surroundings that it is very difficult to see, and it will not take flight again until one nearly treads upon it. It does not care to fly much during the day, except when the weather is dull, or when it is raining. I have seen them flying gaily in the midst of a tropical shower. Towards sunset they begin to get more lively, and may then be seen flitting across the pathways or sporting in forest glades; and long after sunset I have seen them flying wildly, and at a considerable elevation. They are decidedly crepuscular in their habits. It is rather a difficult butterfly to catch notwithstanding its apparently weak style of flight; but this may be accounted for by the fact that when disturbed it generally flies low among the herbage, and flits in and out between the bushes where it is not easy to follow it with one's net. It soon becomes worn, and not one half of those netted are fit for the cabinet. Indeed bred specimens very often look slightly worn although they may not have once flapped their wings. The least touch marks them, their wing-scales are so loose and delicate.

The eggs are deposited, five or six in a row, upon the terminal blades of sugar-cane, and upon various coarse grasses, *Cladium*, &c. It is difficult to understand what method is adopted by the parent butterfly in her selection

of the plant. There may be a dozen clumps of grass or sugar-cane growing close to each other, and to all intents and purposes exactly identical to the human eye, but larvæ will only be found perhaps on two of them, while the other ten will be entirely untouched. Upon one occasion, by the side of a path through the bush near Suva, I noticed seven clumps of, I think, wild sugar-cane growing about a yard apart. The first plant had been much eaten, and a very superficial glance disclosed a number of larvæ, chrysalids, and empty chrysalis cases. The next two plants were untouched, but the fourth was very much eaten; and, in addition to full grown larvæ and chrysalids, I counted upon the under-side of one of the leaves near its tip, no less than twenty-six small larvæ and fourteen ova. The other three plants were intact. It is unaccountable why some of these plants should be selected and the others passed by when, as I have before remarked, to an ordinary observer there does not appear to be a bit of difference between them. Upon these same plants, which were so tasteful to *M. leda*, I also noticed larvæ of *Pamphila angustula*, Herr.-Schäff., but they did not occur upon the others.

Notwithstanding that so many young larvæ and ova occurred upon a single leaf, I should not on that account call the species gregarious; for the numbers were, without doubt, the offspring of several females, as the young larvæ were of different sizes. It should perhaps be called semi-gregarious, for I watched several females depositing ova, and found that they usually laid from five to seven, rarely more. As a rule it was not an uncommon thing to find seven or eight full-grown larvæ, or a like number of chrysalids, upon one plant. The larvæ are very easy to see, for they generally rest on the midrib on the underside of a leaf close to where they have last fed, and do not crawl down and hide themselves among the lower stems. They feed during the day and probably by night also. When full grown they descend to a lower part of the plant, and attach themselves to a pad of silk spun on the midrib of the underside of a leaf. The chrysalids are easily found by moving the stems aside. They do not appear to suffer from the attacks of ichneumons as all the larvæ and chrysalids I took produced perfect butterflies. But I have found fresh chrysalids, which have just assumed that state,

being devoured by small red ants, which appear to attack them when they are on the point of changing, and before the tissues have had time to harden.

The newly-laid egg, viewed through a lens, is perfectly globular, smooth, shining, and pale straw-yellow. In the course of twenty-four hours it turns to a pale yellowish green, and a few hours before it hatches the black head of the young larva becomes plainly visible.

The young larva is pale straw-yellow, with a few short, scattered brown hairs; head black and shining, with minute rudimentary spines upon the crown. The anal processes are scarcely visible. After its first change it becomes pale green with a darker dorsal stripe, pale yellowish green subdorsal and spiracular lines, and a few bristly hairs upon the head and each segment; head black and shining, with the spines upon the crown slightly more developed.

After the second change it is pale yellowish green, with dorsal, subdorsal, and spiracular lines brighter, and anal processes more conspicuous; crown, and sides of face black; spines on crown well developed, black; other portion of head covered with short, black, bristly hairs; just above the mouth an oval, and on each side of the face, a linear-shaped, green blotch.

After the third change the larva becomes altogether a brighter green, the head the same; spines on crown reddish brown, forming a dark line on each side of the face to the mouth; head, spines, and anal processes clothed with fine whitish hairs; hairs on body replaced by raised yellowish dots. The full-grown larva is elongate and subcylindrical with the second segment very narrow, and the anal segment produced into two processes terminating in sharp points; head very large and conspicuous, apple-green, and furnished with two carmine, rigid, spines on the crown, the carmine changing to black from the base of the spine to near the mouth on each side of the face, and bordered posteriorly by a narrow white stripe; whole of the upper surface bright apple-green, sometimes inclining to golden-green, irrorated with raised yellow dots, which, seen through a lens, emit short whitish airs, and give the larva a somewhat roughened appearance; between the subdorsal stripe and spiracles a stripe of darker

green; dorsal line dark green; lateral skin-fold well developed; under surface, legs, and prolegs dull green.

When full-grown the larva remains perfectly motionless for twenty-four hours or more, gradually shrinking all the time, and then falls suspended head downwards, its anal claspers attached to a pad of silk which it had previously spun, and, in this position it remains for about another twenty-four hours, when it changes to a somewhat obtuse chrysalis of the usual satyrid form, with slightly bifid head. Its whole surface is beautiful grass-green, the veins of the wing-cases being slightly darker. The wing-sheaths, considering the ample wings of the butterfly, are comparatively small. The butterfly emerges in about ten days.

When not feeding the larva has a habit of crawling to the extremity of a leaf, where it rests with its head and first three or four segments hanging over and downwards, and, in this position, especially when viewed sideways, bears a strong resemblance to a praying mantis, and so, to a certain extent, may alarm any wandering ichneumon. A wise provision of Nature!

Epinephele abeona, Don. (Pl. VI., fig. 8).

This beautiful species is not uncommon near Sydney, but is local and only occurs in deep wooded gullies where different species of *Cladium*, upon which its larvæ subsist, grow in dense clumps by the margins of water-courses, or in low swampy ground between ranges of hills. It flies in an irregular uncertain manner around its food plant, or amongst brushwood in its vicinity. It is very conspicuous on the wing, and a pleasing object. Occasionally it settles upon a stone and expands its wings to the full glare of the sun. Once or twice I found them, towards dusk, roosting in little parties in miniature caves in the face of a sandstone cliff overlooking a swampy valley, and have seen them in similar situations during a shower.

I long suspected that the larvæ would be found feeding upon *Cladium*, as I noticed that the perfect insects were only to be met with where these plants grew, but it was not until October 27th, 1883, that I had the pleasure of discovering the larvæ.

I was out for a day's collecting in a small valley at

the back of Coogee Bay, about four or five miles from Sydney. A little rivulet runs through the centre of the valley, and here and there there were swampy places overgrown with coarse grass, rushes, ferns, and patches of *Cladium*, the hills on each side being clothed with the usual *Eucalypti*, *Banksia*, *Persoonia*, &c. I walked up the valley for nearly a mile when I came to a wall of rock, out of, and over which, the little stream dashed and splashed, and formed several cool and delicious-looking pools. The face of the rock was studded with patches of various kinds of lovely ferns, and a large and delicate species of *Pteris* (*P. tremula*) grew in masses at its base. Altogether it was a romantic spot, and well suited for a picnic party. Several specimens of *abeona* were disporting themselves here among the *Cladium*, which grew luxuriantly in large masses, and I noticed that some of the leaves had recently been nibbled, so I had a good hunt, and succeeded in finding some very small larvæ hiding away among the leaves at the base of the plant. These were evidently the larvæ of a *Satyrid*, and could be none other than those of *L. abeona*, which, indeed, they proved to be. I could discover no full-grown larvæ on this occasion, but a few days later I again visited this valley, and in another locality, a short distance from the waterfall, I was delighted to find four full-grown larvæ, and numbers of smaller ones. The latter I did not take, as I found the food-plants would not keep fresh; in fact the leaves shrivelled up before I got home, so the only chance I had of breeding the perfect insect was by taking the full-grown larvæ. Subsequently I dug up a few small plants and put them into pickle-bottles with wet sand, and then had no difficulty with my larvæ, for the plants kept nice and fresh for some weeks. A few days after this I succeeded in finding the beautiful emerald-green chrysalis, and during the remainder of my stay at Sydney I took numbers of both larvæ and chrysalids, and bred a good many butterflies.

This species appears to occur throughout the year. I have taken it in all its stages from August to May, but having spent no part of June or July at Sydney I cannot speak positively with regard to those two months.

The egg, which is perfectly globular and shining emerald-green, is laid upon the upper surface of the

leaves of the food-plant. The young larva has a very large head, out of all proportion to the rest of the body, shining black, very minutely punctured, and sparsely clothed with fine reddish brown hairs. Colour pale golden green inclining to rosy on two posterior segments; dorsal line faint, pulsating, and pale rosy; a few stiff reddish brown bristles upon the two posterior segments.

Full-grown larva cylindrical, tapering slightly towards each extremity; head subcordate, somewhat flattened and porrected, narrower than second segment; anal segment produced into two sharp conspicuous points. Ordinary colour a beautiful pea-green, but inclining, in some individuals, to a pale yellowish green; a dark pulsating dorsal line, bordered by a dull green stripe, next to which is a pale yellow-green line; an indistinct darker subdorsal line; whole larva tranversely wrinkled, especially the anterior and posterior segments; anal points faintly tipped with purple; under surface, legs, and prolegs paler; mouth black, bordered with white; ocelli and spiracles very minute and black. A common variety of this larva has a beautiful, but somewhat interrupted, purple dorsal stripe.

When full-fed the larva attaches itself by its anal hooks to a pad of silk, spun on the underside of one of the lower leaves of its food-plant, or to a neighbouring twig, and changes to a short, stout, and somewhat obtuse chrysalis, with slightly bifid head. Colour beautiful emerald or grass-green; dorsal line darker; inner margin of wing-sheath bright yellow; spiracles minute, faint yellow.

The leaves of the *Cladium* possess exceedingly sharp edges so that it is almost impossible to search for these larvæ without returning home with one's hands and wrists considerably cut.

Acræa andromacha, Fabr. (Pl VI., figs. 14, 14 (*a*)).

This butterfly is local at Sydney, but uncertain in its appearance, at times being very abundant. It flies in a slow floating manner, and when in the net frequently feigns death. It is very tenacious of life, and requires a strong and prolonged squeeze to kill it. Towards sunset they assemble in numbers, and are fond of

roosting at the extremity of dead twigs, and, when in this position, can be easily captured between the finger and thumb.

On April 14th, 1883, I discovered the larvæ in a garden at Darling Point, Sydney, feeding upon a hedge of *Taxonia*. They were in the utmost profusion, and of all sizes, from the tiny individuals just hatched to the full-grown larvæ. In their earlier stages they are gregarious in their habits, but as they grow older they separate and wander about. Their chrysalids were hanging everywhere, and the butterflies were flying about in numbers.

On April 24th we left Sydney for a cruise. I then had a dozen larvæ still feeding, but in a few days all the food died and shrivelled up. I expected that the larvæ would die also, but to my astonishment they all crawled to the top of the breeding-cage and there fixed themselves to a pad of silk, and remained perfectly quiet, as if with the intention of hybernating. On May 13th, at Suva, Fiji, I placed three large *Noctuæ* larvæ in their box, but these did not disturb them in the least. In about three weeks I bred a beautiful moth from one of these larvæ, and as it was rather lively I dropped a few drops of chloroform into the box to stupefy it, and this had the effect of rousing the *Andromacha* larvæ, and most of them fell writhing to the bottom of the box. Next day several of them were dead. At the beginning of June, when we were among the Gilbert Islands, within a short distance of the line, the remaining four or five larvæ, which were very small half-starved looking creatures, began to move about, attached themselves in the usual manner, and in a few days changed to chrysalids. Between June 11th and 18th these produced very dwarfed butterflies. From the above it would seem that these larvæ have the power of abstaining from food for a lengthened period, which will account for the uncertain appearance of the perfect insects.

The full-grown larva is 30 to 35 mm. long, cylindrical, deep sienna-brown, and somewhat shining, with rows of long slender, subdorsal, spiracular, and subspiracular branched spines, the bases of which are seated upon slightly raised metallic, blue-black spots; dorsal and subdorsal stripe paler than general ground colour; head pale sienna-brown with black blotch on face, and a

V-shaped paler mark; legs and prolegs black; ventral area pale greenish yellow.

When full-fed the larva attaches itself to a pad of silk on the under side of a leaf, or stem of its food-plant, and hanging, head downwards, changes to a conspicuous and rather elongated black and white chrysalis, with a subdorsal and spiracular series of orange spots.

I have also taken this species at Brisbane, Fiji, New Hebrides, Thursday Island, and New Guinea.

Pyrameis Itea, Fabr., (Pl. VI., fig. 10).

This species was not uncommon in the neighbourhood of Sydney, but it was not abundant, for its food-plant, *Urtica incisa*, was very scarce. Indeed I only remember having seen one small plant growing under a wall in one of the suburbs, and this had several larvæ upon it. The nettles probably occurred in gardens, or waste places, not generally accessible to the public, or the larvæ may perhaps feed on something else as well. The butterfly was occasionally to be seen in the very heart of the city. It is fond of alighting upon walls, or upon trunks of trees, and invariably settles with its head downwards. It is a very rapid flier. The larvæ were very abundant at Hobart, Tasmania, in February, 1883, and I took a plentiful supply from a bed of nettles in a garden in the town, and bred a fine series of the perfect insect. I also met with the larvæ at Blackheath, on the Blue Mountains, in February, 1885, and I have received bred specimens from Norfolk Island, where it appears to be common. The eggs are laid singly, upon the terminal shoots of nettles (*Urtica incisa*), and although the larvæ are not, strictly speaking, gregarious, yet the same female appears to deposit a number of eggs upon the same plant. Directly the larvæ are hatched they proceed to spin the edge of a leaf together, and form a little tent in which to dwell, issuing forth from time to time to feed. They live in tents the whole course of their existence, constructing larger ones as they increase in size. But it sometimes happens that there are so many larvæ upon a single plant that they eat each other out of house and home, and may then be seen feeding quite exposed. When full grown they attach themselves by the anal hooks to a spray of their food-plant, or

wander to some adjacent wall, or paling, where they turn to a somewhat angulated chrysalis with blunt abdominal spines. The colour of the chrysalis varies, and depends upon the locality where they have effected their change. If against a wall they are reddish brown with a few abdominal silvery spots; but when attached to their food-plant they are beautiful objects, being like burnished gold, or opalescent golden green. They emerge in ten days or a fortnight.

The full-grown larva is from 30 to 32 mm. long, cylindrical, tapering towards each extremity; head cordate, notched on the crown, slightly hairy and much larger than the second segment; whole of the dorsal and subdorsal area smoky black, in some varieties dark hoary grey; dorsal stripe narrow and black; sometimes an interrupted white, or whitish yellow subdorsal stripe, bordered below with black; subspiracular area olive-green or olive-yellow; lateral skinfold well-developed, and pale yellow; spines small, branched, and blackish, or reddish brown, with the exception of those upon the lateral skinfold which spring from a reddish cushion, and are olive-yellow; ventral area smoky olive; legs black.

Junonia vellida, Fabr. (Pl. VI., fig. 11).

This is a common butterfly and appears to be pretty generally distributed. It occurs in open waste places, flies rapidly to and fro when disturbed, and alights abruptly upon a stone, or clear place, on the ground, keeping its wings expanded to the sun. The larvæ, near Sydney, feed upon *Plantago major* and *Plantago lanceolata*, and are not difficult to find. In the Botanical Gardens, I frequently noticed them upon *Antirrhinum*, and at the Friendly Islands they were feeding upon sweet potato; and at the Gilbert, Ellice, and Marshall Islands they were to be seen living quite exposed upon the broad, succulent, and glabrous leaves of a species of *Daphne* (?), and they probably feed upon a variety of other plants. I met with it at Sydney, Brisbane, Thursday Island, Hobart, New Guinea, Fiji, New Hebrides, New Caledonia, Samoa, Friendly Islands, Rotumah, Gilbert, Ellice, and Marshall Islands. The perfect insects vary considerably in different localities, the most marked variety occurring at Samoa.

The full-grown larva is from 37 to 40 mm. long, cylindrical, rather stout in proportion to its length, and tapers slightly towards the head; whole surface deep blackish brown, darker in some individuals than in others, and almost approaching a velvety black; a series of dorsal, subdorsal, spiracular, and subspiracular short, and rather blunt, finely-branched spines; a greyish lunular stripe upon each segment above the spiracles; a faint, and somewhat interrupted, whitish grey spiracular line; head black, cordate, notched on the crown, with a very short blunt spine on each side, and sparsely covered with fine black hairs; second segment, when head is stretched out for crawling, exhibits an orange-coloured collar; legs black; ventral and anal claspers tipped with tawny, and with tawny spots at the base.

The chrysalis, which is short and obese, is attached by its anal hooks to a pad of silk on the under side of a leaf, a stem, or an adjoining stone, and is dark umber-brown, speckled with greyish dots and blotches.

Doleschallia Herrichii, Butl. (Pl. VI., figs. 13, 13 (*a*)).

This fine species was rather scarce at Havannah Harbour, Sandwich Island, and at Aneiteum, in the New Hebrides, from June to August, 1882. It is very strong on the wing, and fond of flying rapidly backwards and forwards in front of some high tree, and when it settles it generally does so far out of reach. It is ever ready to give chase to any passing butterfly, consequently nearly all those captured were more or less worn.

At Aneiteum, in August, I was fortunate to find its larvæ in some numbers, and succeeded in breeding a good series. Strange to say although such a high-flying butterfly, the larvæ were always found upon a low growing shrub, the name of which I am unacquainted with.

The eggs are laid in little batches of twenty or thirty all close together; they are quite round, and pale glossy yellow. The young larvæ are gregarious, but after changing their first or second skins they break up the family party and each larva starts forth on its own account. From observations made I am inclined to believe that they have the power of doing without food

for a considerable period, and wander to a great distance, for adult larvæ are found singly on bushes a long way apart.

When full-grown the larva feeds perfectly exposed upon its food-plant, and is then a conspicuous object. It is from 52 to 55 mm. long, cylindrical, and tapers slightly towards the head, which is cordate, and notched on the crown, with a stiff branched spine springing from each lobe; cheeks, lower part of face and mouth, deep metallic blue, almost black; the second and third segments much narrower than the head; whole of the dorsal and subdorsal area, as far as spiracular stripe, bluish or purplish, sometimes inclining to deep madder, and irrorated more or less with inconspicuous whitish dots; dorsal vessel interrupted, black; a subdorsal interrupted pale whitish stripe; an interrupted white spiracular stripe; ventral area, legs, and prolegs smoky greenish yellow; from fourth to tenth segments inclusive five, upon second and third four, upon twelfth six, and upon thirteenth four rigid, branched, blue-black spines, spring from a circular metallic blue-green base; from fifth to twelfth segments inclusive, interrupting the white subspiracular stripe, a conspicuous orange-red cushion seated on the lateral skinfold, and from which spring yellow branched spines tipped with black; spiracles minute and black.

When full-grown the larva spins a pad of silk to the underside of a leaf, attaches itself thereto, and becomes a smooth chrysalis of a reddish buff colour; a curved black line runs from the tail along the inner margin of the wing-cases to the eye, which makes it appear somewhat boat-shaped; spiracles, and some subspiracular dots black, with a few black dashes and striæ upon the wing-cases and abdomen.

These larvæ were taken between the 26th and 29th August at Aneiteum. They were very sluggish in their habits and flaccid to the touch, and were considerably infested by a dipterous parasite, and I lost several that were so attacked. The affected larvæ, when full-grown, ceased feeding, and remained stationary for two or three days, when they lost the power of holding on by their legs and anal claspers, and these two extremities falling, they were left suspended by their prolegs only, in a doubled-up position. Upon examination they were

found to contain some black fluid, and one fat maggot, which, in due course, produced a common-looking fly. Many of the larvæ turned to chrysalids during our passage to Sydney, but I lost a number of them from want of food. The first butterfly emerged at Sydney, on 16th September, and I bred altogether about two dozen fine specimens.

Hypolimnas bolina, Linn.

This is a very elegant butterfly, and its flight is most graceful. The males are fond of congregating in little parties of a dozen or more, in some shady nook, where there may happen to be any of the large-leaved trees or shrubs upon which they delight to sit, and, as one passes, they fly out in little flocks. It is then a pretty sight to watch them. One or two will go off rapidly as if in a great fright, but the remainder wheel backwards and forwards slowly in front of the spot from whence they started, and, if one keeps perfectly quiet, will settle again in the same place. They look very lovely as they thus float to and fro in a lazy, airy fashion, their dark blue-black velvety wings, with bright violet-blue centres, flashing a variety of brilliant rays in the bright sun, and making them appear like fairy gems. The females are more solitary in their habits, but are to be seen more constantly on the wing flying steadily along, on the look out for a suitable plant on which to deposit their eggs. They vary excessively, scarcely any two being alike, and some of the varieties are remarkably beautiful. The males, on the other hand, never show the least disposition to vary. The females seem to have regular beats, and appear to stick to the same spot for days, probably for the whole period of their existence. Often, while walking along a path through the forest, a female has flown out of a thick bush in front of me, and, day after day, as I passed the same spot, what I believe to have been the same butterfly has appeared. This was constantly occurring. Towards sunset the males assemble in large numbers, and "roost" together, and I have frequently beaten three or four dozen from the same bush.

The larvæ are not at all difficult to find, and, in some places, were most abundant. When feeding on *Sida rhombifolia* they have a habit of crawling high up

on their food-plant, towards evening, and are then conspicuous objects; and after heavy rain they wander about a good deal. The chrysalids were not uncommon, attached to twigs of the food-plant, or upon some neighbouring bush. In the hope of breeding some good varieties, I took, at different times and in different localities, a great number of larvæ, and succeeded in rearing a large series of butterflies, among them some fine and interesting varieties. The larvæ did not suffer much from the attacks of ichneumons, for only one out of the number I took was stung. They remained about three weeks in the chrysalis state.

The larvæ feed upon *Sida rhombifolia* and *Sida retusa*, and also upon a convolvulus which creeps over the ground in stony waste places; it also, I believe, feeds upon various species of *Portulaceæ*, and probably upon other low plants.

The eggs are laid in irregular batches upon the undersides of the leaves, and, when quite fresh, are pale yellow, but they change to a deep leaden-colour just before the larva emerges. Viewed through a lens the eggs are orange-shaped and finely ribbed. When quite young the larvæ are gregarious, but separate after the second moult. The young larva is dark greenish black; head black and shining, with no indications of the spines on the crown possessed by the adult larva: body spines represented by fine bristles, curved slightly forward; ventral area transparent yellowish green.

The full-grown larva is 52 to 55 mm. long, cylindrical, tawny black, with seven branched spines upon each segment, arranged in a ring; head cordate, reddish yellow, with a long branched spine springing from each side of the crown; second segment manifestly narrower than the head, and of the same colour; a somewhat interrupted sienna-brown spiracular stripe, most conspicuous upon the third and fourth segments; spines dark reddish brown, thickly branched with fine black bristles; legs, prolegs, and ventral claspers reddish brown; whole surface irrorated with very minute yellowish dots.

When ready to change the larva attaches itself to a pad of silk on the underside of a leaf or twig, and turns to a slightly angulated dark brown chrysalis, with abdominal spines, two blunt spines at base of wing-sheath,

and one or two on the thorax. I only noticed one variety of the larvæ; they were light reddish grey, clouded with ochreous-yellow, with the region from which the spines spring entirely ochreous-yellow, formin a series of rings; spines reddish yellow; spiracles black; a few black dots behind each subdorsal spine; subspiracular skinfold ochreous-yellow, and well developed, almost forming a lateral stripe; ventral area bluish grey; chrysalis from this variety pale reddish grey.

This butterfly is occasionally to be seen in the vicinity of Sydney, but I never met with it there myself. I have taken it at Brisbane, Cooktown, Claremont Islands, Thursday Island, Fiji, New Caledonia, Friendly Islands, New Hebrides, Rotumah Island, Solomon Islands, Gilbert Islands, Marshall Islands, Ellice Islands, Caroline Islands, Samoa, Pelew Islands, New Guinea, New Britain, and have received it from Norfolk Island.

Note.—On account of the extraordinary manner in which the females vary,—it being extremely difficult to obtain two exactly alike from the same brood of larvæ,—a number of new species have been described, among which I may mention *naresii*, *mosleyi*, *pallescens*, *pulchra*, and *montrouzieri* of Butler, and *otaheitæ*, Felder.

Lycæni heathi, Cox.

This species was local near Sydney, occurring only where its food-plant, *Westringia rosmarinifolia*, a shrub of from three to four feet high, and bearing clusters of white flowers, grew. This plant was chiefly confined to open ground near the sea,—though I found it sparingly in one or two localities a few miles inland,—so that the butterfly to a great extent is a maritime species. I had long noticed that it was only to be found in one or two places where this shrub grew, and had a suspicion that the larvæ fed on it, and beat it once or twice without discovering any. However, on February 28th, 1885, happening to be at one of its localities—a point jutting out into Botany Bay—I beat the bushes again into my net, and this time succeeded in obtaining a dozen full-grown larvæ of a *Lycæna*, which I thought would produce this species. There were plenty of small larvæ besides, but I did not take these. The full-grown larva

is of the usual *Lycæna* form, 13 to 15 mm. long, rather slender in proportion to its length; whole surface a beautiful pea- or apple-green, in some individuals the green upon the dorsal area being tinged with golden-yellow; viewed through a lens the whole body is irrorated with minute whitish dots, and a few short light-coloured bristles spring from the spiracular region, and above the head and anal flap; segmental divisions clearly defined; four short dark-coloured dorsal bristles upon each segment, springing from small tubercles; the tubercles on fourth, fifth, and ninth segments being often tinged with carmine, with a faint indication of that colour upon the others; in some of the larvæ these tubercles are very indistinct; a ridged sub-spiracular yellow line; spiracles very small and pale yellow; the twelfth and thirteenth segments somewhat flattened, and, from the dorsal surface of the latter the larva has the power of emitting two short whitish tentacles, the tips of which are furnished with a whorl of minute bristles; head pale amber colour, mouth darker, with a dusky round dot on each side of it. The tubercles on third and fourth segments are double. The half-grown larvæ are of a light greenish yellow, with a dark pulsating dorsal stripe, and very faint indications of dorsal tubercles. The larva feed upon the flowers and flower-buds, and also upon young leaves, eating holes from beneath in the centre of the leaf, but do not penetrate through the upper cuticle. When full-grown they attach themselves to the underside of a leaf, or to a stem. The chrysalis is from 10 to 11 mm. long and much resembles a chiton; the abdomen is considerably depressed and ridged laterally; the segmental divisions are clearly marked and ridged. The colour varies, those attached to the leaves being greenish yellow, or pinkish brown, while those attached to the stems are nearly black, and they are all more or less sprinkled with dark dots and pencilings; spiracles pale yellowish enclosed in a reddish ring.

The first butterfly appeared on our passage home at Batavia, on June 9th; the last in the English Channel, on August 26th, the day before we arrived at Plymouth.

Ialmenus evagoras, Don.

The larvæ of this beautiful butterfly live in society upon the "Wattle" (*Acacia*). On October 4th, 1884, I found, upon a small branch of "Wattle," at Paramatta, near Sydney, one pupa, a larva upon the point of changing, and a number of small larvæ, from tiny individuals just hatched to others nearly half-grown. This was evidently an early brood. At the same place, on February 9th, 1885, there were many of the perfect insects on the wing, and upon some young "Wattle" bushes, from two to three feet high, I noticed several clusters of pupæ-cases, one batch of fifteen which had not emerged, and numbers of larvæ of all sizes. The larvæ and living pupæ were attended by scores of small black ants, which continually ran backwards and forwards over them, and, as far as I could see, caused them no annoyance. The ants were attracted by some sticky saccharine matter which exuded from both larvæ and pupæ, and gave them a bright and varnished appearance. Upon placing my face close to these nests I fancied that I could detect a faint and rather sickly aromatic odour. Many of the butterflies were setting on the twigs among the larvæ and pupæ, and did not seem to be at all disturbed by the ants, although they flew away when I approached too near, but upon passing again in an hour's time they had renewed their old position. They are evidently rather sluggish in their habits, and do not appear to wander far from their food-plant, and from the above I should say that there are a succession of broods from spring to autumn, and that young bushes are selected in preference to older ones.

The larva a few days old is pale reddish brown, inclining to greenish upon the back, and with its whole surface covered with a few pale-coloured hairs; tubercles small, but plainly visible; head shining black.

The full-grown larva is 15 to 18 mm. long, subcylindrical, tapering to each extremity, and of a shining smoky greenish hue, in some individuals almost black; a pale yellowish green and somewhat interrupted stripe encloses the spiracles, and widens out considerably upon tenth and eleventh segments; a pair of blunt, double, fleshy, dorsal spines on second to tenth and on twelfth segments, those on third, fourth, and twelfth segments

much wider apart than the others, and those on fourth segment the longest; a short blunt spine just above the spiracles on all the segments except eleventh, twelfth, and thirteenth, those on seventh, eighth, ninth, and tenth being the most conspicuous; there is also a minute tubercle below each spiracle; an oblique narrow white line on each segment between the dorsal and spiracular spines; spiracles white in a black ring; a whitish spot at the base of most of the spines; under parts and claspers pale green; legs black; a few fine whitish bristles spring from the second segment and point over the head, and there are also scattered bristles along the spiracular region, chiefly above the claspers; all the spines are tipped with minute blunt bristles, which are, however, scarcely perceptible to the naked eye; segmental divisions clearly defined. The tubercles upon the twelfth segment have a small valvular opening at their summit, through which, when the larva crawls or is feeding, a telescopic organ surmounted by a whorl of fine bristles is constantly thrust.

Pupa attached to stem of food-plant; usually several close together; rather short and stumpy; shining reddish brown and black; wing-cases black, veins light sienna-brown and conspicuous; segmental divisions reddish, clearly defined; faint indications of tubercles on back; spiracles raised, pale reddish brown.

Elodina angulipennis, Luc.

This is rather a weak-flying butterfly. It was very numerous in the Botanical Gardens, Sydney, in April and May, 1884, and in March, 1885, frequenting the different *Capparis* bushes. I had not noticed it in 1882 or 1883. On May 12th, 1884, I watched a female depositing her eggs upon the tender leaves and terminal shoots of *C. nobilis*. Muëll. The eggs are subconical and finely ribbed, and when freshly laid are pale straw-yellow, which changes in a day or two to a semi-transparent whitish hue spotted with pink. Unfortunately I was unable to carry on further observations regarding this species, as we left Sydney on May 17th for a cruise to the islands.

Pieris latilimbata, Butl. (Pl. VI., fig. 4).

This butterfly was very abundant in all its stages at Port Moresby, New Guinea, in November, 1884, and I also met with it on April 13th, 1885, at one of the Claremont Islands, off Cape Claremont, on the north-east coast of Queensland.

The larvæ feed upon a straggling thorny shrub bearing alternate suboval leaves, and possessing shining pubescent stems, which feel like velvet to the touch, and are of exactly the same colour as the larvæ. The larvæ live perfectly exposed, and when not feeding rest on the midrib of the leaf or upon an adjoining twig, and, upon being annoyed, throw their heads backwards and remain in that position for some time.

The full-grown larva is 28 mm. long, cylindrical, dull pea-green, and thickly irrorated with numerous transverse rows of small yellow raised dots, interspersed with fine short white hairs, especially upon the spiracular region; an indistinct and somewhat interrupted pale yellowish line just above the spiracles; head the same colour as the body, and covered with raised yellow dots and short scattered hairs; ventral area pale greenish grey.

The chrysalis is attached to a pad of silk on the under surface of a leaf, or to a stem. On several occasions I noticed it upon the upper side of a leaf. Its general colour is bright apple-green, and it is much angulated. The sheath of the haustellum forms a prominent beak, the wing-cases are produced into sharp spines, and the posterior segments narrow suddenly to a point. A large indented and somewhat triangular pale-coloured blotch extends across the abdomen; a raised yellow lateral ridge from base of wing-case to anal extremity; abdominal divisions clearly defined, pale yellowish green, with three or four small raised black dots on the apex. In some varieties the green is replaced by reddish green, and one or two larvæ which underwent their change in a chip-box became chrysalids of a uniform ashy-grey colour.

Pieris teutonia, Fabr. (Pl. VI., figs. 6 and 6 (*a*)).

This species, which seems to be local, was particularly abundant near the menagerie in the Botanical Gardens

at Sydney during May, 1882. It is a quick-flying insect. There were scarcely any flowers attractive to butterflies in bloom in the gardens at this time of the year, only a few passing Zinnias, and upon these *P. teutonia* occasionally settled. It was fond of resting upon shining evergreen leaves, where it would remain motionless for a considerable time, with extended wings, enjoying the full glare of the sun. It is of uncertain appearance, being abundant at some seasons and entirely absent or very rare at others. In the summer of 1882—83 it occurred in the greatest profusion, especially the second brood, which were in countless numbers; the topmost boughs of the caper-trees in the Botanical Gardens were stripped of their leaves, and the chrysalids were attached thickly to every twig, but I saw it nowhere else.

In 1884 I only noticed two butterflies (on April 18th), and three larvæ (on May 12th), and in 1885 there were none seen in the gardens, but I met with a single butterfly at Blackheath, on the Blue Mountains, on February 14th. It is strange that in 1884—85 the same caper-trees that were infested with *P. teutonia* in 1882—83 were frequented by numbers of *Elodina angulipennis*, Luc., a species I had not previously observed, and I noticed the females busily engaged depositing their eggs upon the caper-leaves. I may here remark that the two broods of *P. teutonia* are very different in appearance, the females of the summer brood being very deeply margined with black, particularly the hind wings, which in some cases are almost entirely black, and the orange-yellow markings beneath are much brighter.

This species is widely distributed. I have taken it at Fiji, New Hebrides, Friendly Islands, and New Guinea. It varies slightly in each locality, but not sufficiently to constitute a distinct species, or even a well-marked variety. Near Ne-afo, Vavua Island (Friendly group) it must have been in immense numbers in the summer of 1884, for one day, when I was out duck-shooting upon a lagoon, I noticed hundreds of caper-trees by the water's edge almost stripped of their leaves; and there were still a good many butterflies to be seen, although they were mostly passing. The native who was with me in the canoe could speak a little "pigeon" English, and he said that a month before they were in "*plenty, plenty*," greatly emphasising the expression. I have

heard of immense flights of white butterflies having occasionally been seen in Queensland, proceeding at a considerable height from east to west, and should think it likely that they were this species.

On May 15th, 1882, I noticed a female fluttering about the topmost shoots of a small bush of *Capparis lasiantha*, R. Bth., and upon examination discovered hundreds of eggs, laid in batches of a dozen or more; they were of the usual *Pieris* type and bright straw-yellow. There were also numbers of larvæ of all sizes, but none of them appeared to be quite full-grown. I took a few of the largest. A day or two afterwards, while picking some fresh food for these larvæ, I found a number of empty chrysalids, two of which had the freshly-emerged butterflies sitting drying their wings alongside of them. I also picked two which had not come out, and which appeared a few days after in my cabin. When full-grown these larvæ appear to wander, for I noticed several empty chrysalids upon adjoining shrubs. The tree these larvæ were upon was rather a stunted unhealthy-looking one of its kind, and, although there were others close at hand in a flourishing condition, I could not detect that they had been in any way touched. This peculiarity I have noticed with other species. From January 4th to 20th, 1883, larvæ and chrysalids were in immense numbers upon three kinds of caper, *Capparis nobilis*, Muell., *C. Mitcheli*, Lindl., and *C. lasiantha*, R. Benth., and I bred a large series of the butterflies.

The full-fed larva is cylindrical, and tapers at each extremity, especially the anal; head somewhat cordate, black, with a few minute yellow dots and scattered whitish hairs, and a white V-shaped mark on the face; whole of the upper surface, which is glaucous, dark olive-brown, thickly irrorated with very minute yellow dots; on the second segment, immediately behind the head, a series of three raised gamboge-yellow dots on each side of the dorsal vessel, and a single dot below, the whole forming a narrow ring; from each of these dots spring minute whitish hairs; on the third and fourth segments a row of six dots encircling the dorsal area; from the fifth to the twelfth segments inclusive these dots are arranged in a triangular pattern, and on the thirteenth segment they form a small patch, with two additional dots, which are rather conspicuous just

above the anal flap; dorsal line much darker; spiracular line indistinctly defined, and pale yellowish green; spiracles black, in a pale yellow ring, with a bright yellow dot just below each; between the spiracular line and base of prolegs and claspers there is a stripe of smoky green, from which grow a number of fine white hairs; ventral area yellowish green.

When full-grown the larva crawls to the back of a leaf or to a twig, spins a pad of silk in which to insert the anal hooks, girds itself with a silken thread, and in about twenty-four to thirty hours changes to a greenish grey and slightly angulated chrysalis. In some cases, however, the larva does not leave the leaf upon which it last fed, but becomes a chrysalis, quite exposed, upon its upper surface. A few hours before the exit of the butterfly the markings of the wings are plainly visible through the sheath.

Callidryas Gorgophone, Fabr. (Pl. VI., fig. 7).

This butterfly was not common at Sydney; I only noticed it once or twice, and took but one specimen. It is not easy to catch, for it usually flies at a headlong pace. One day, early in March, 1885, I observed a female flying about a *Cassia* bush in the Botanical Gardens, and upon examining it discovered a number of eggs, some small larvæ, and one chrysalis. This was the only bush of the kind in the gardens, though there were plenty of bushes of other species, *C. candoleana*, &c.; but I could find no traces of larvæ upon any of these. I took three or four dozen larvæ, and found them very easy to rear.

Full-grown larva 35 mm. long, cylindrical, beautiful apple- or grass-green, tinged below with yellow; whole body delicately ribbed and finely pilose; a conspicuous pale yellow spiracular stripe, above which, upon each segment, are two or three dark metallic-blue spots; viewed through a lens the body is thickly covered with minute brownish tubercles, which give the larva a slightly roughened appearance; head paler than rest of the body; under parts and ventral claspers pale yellowish green. The young larvæ a day or two old are yellowish green. They feed perfectly exposed upon the upper surface of the leaves, and when not feeding have a habit of keeping

their heads and anterior segments raised *Sphinx*-like: they grow very rapidly, and when full-fed attach themselves to a stem of their food-plant and change to a slightly angulated chrysalis, pale greenish yellow, with a conspicuous yellow spiracular stripe. The butterflies appeared in ten days or a fortnight, and invariably emerged just before dawn. Shortly before they were disclosed the wing-cases of the males became a beautiful yellow, and the spots could be plainly discerned at the margins of the wings; the females were much paler. The chrysalis of this species is not nearly so angulated, nor are the wing-cases or sheath of proboscis so produced as in many others of the genus. I have also taken this butterfly at Brisbane, Claremont Islands, and Thursday Island. None of my larvæ were ichneumoned.

Eurycus cressida, Fabr. (Pl. VI., fig. 12).

This interesting species was common at Thursday Island, and at Brisbane and Cooktown. At the latter place I noticed females depositing their eggs upon some low-growing creeping plant, apparently allied to *Aristolochia*, but failed to find any larvæ. Mr. Miskin, of Brisbane, kindly gave me a pupa, from which I bred a fine male. The butterfly flies straight and moderately high, and looks as if it was weak on the wing, though when it is frightened it can go at a rapid pace. In some places they assembled in large numbers round the flowers of *Eucalyptus*, and on these occasions were, of course, far out of reach.

Ornithoptera.

I shall never forget the intense pleasure I experienced at seeing for the first time, in its native haunts, the magnificent *Ornithoptera durvilliana*. It was on 22nd November, 1882, at Meoko, one of the islands of the Duke of York group, situated between New Britain and New Ireland. We arrived and anchored in the little land-locked harbour, in front of the trader's house, early in the afternoon, and I at once went on shore. Meoko is a small island, not more than three or four miles in circumference, and densely wooded, some of the trees being of immense size and height, and the undergrowth composed of a varied and luxuriant tropical vegetation.

The island is traversed by a number of small paths which connect the different villages. These are of small size, being merely a collection of two or three badly-constructed huts. The natives are not a very enterprising race. The men go about perfectly naked, but the women wear a narrow kind of belt composed of strips of palm-leaves round their waists.

Upon landing I took one of the paths leading into the forest, and had not walked very far before I saw a large butterfly flying backwards and forwards at a great height between two trees. I could see that it was blue and black above, and golden green and spotted beneath, and at once knew what it was. I watched it for some time as it kept sailing to and fro, every now and then descending a little, and making me hope that it was coming within reach; then, mounting again rapidly, it continued its regular beat, until finally it settled among the branches, and I saw it no more. All this was very tantalising. Proceeding onwards, I came to a comparatively open spot, where several of these grand creatures were apparently taking their evening exercise before retiring to rest, the females, nearly twice the size of their mates, looking more like bats or birds than butterflies. It was now getting late, and they disappeared one after another amid the shelter of the high branches. Of course I was exceedingly vexed that none came within my reach, and hoped that I might be more successful the next day. However, I had a piece of good luck on my way back to the ship, for I suddenly saw, about twenty yards to the right of the path, a huge black spiny larva, suspended to the under side of a leaf of some forest-tree. Fortunately it was within easy reach, and I soon had leaf and larva in my hands, when I noticed that it had only recently attached itself, for it protruded its fleshy carmine-coloured tentacles, and otherwise exhibited signs of annoyance. I was overjoyed at my good fortune, for of course this could be no other than the larva of *durvilliana*.*

The next morning I landed directly after breakfast, and, having procured a bamboo about fourteen feet long,

* It changed to a chrysalis in a day or two, and on Christmas day, at Sydney, a splendid male emerged—a welcome Christmas present!

to which I fastened a net, proceeded to the spot where I had noticed the *Ornithoptera* the evening before, and here I remained for the greater part of the day. I also took a spare net with me, and some native boys to carry my boxes and make themselves generally useful. It was rather a dull day, and there were not many butterflies about, but we managed to secure six *urvilliana*,—three males and three females,—but none of them were quite perfect. The females occasionally fly low among the underwood, apparently engaged in depositing their eggs, and the males then often follow them. One of my boys succeeded in catching two at a single stroke of his net—a male and female. I ought to have obtained several others, but, although such large insects, they are not easy to secure, and one gets nervous and excited at the sight of such huge and brilliant creatures; moreover, my nets were far too small. When I got back to the ship I found that some natives had brought a pair of *urvilliana* on board, the male being much finer than any of my captures.

We remained at Meoko the whole of the following day, when I again paid a visit to the forest, and found several larvæ of *urvilliana*, of different sizes, feeding upon a large-leaved *Aristolochia*, which was creeping abundantly in some places over the low brushwood, but I took no more perfect insects.

On July 16th, 1883, we arrived at Matupi, a small island in Blanche Bay, New Britain, and about twenty miles from Meoko. Messrs. Hernsheim & Co., German merchants, have a store there, and do a large trade with the natives in "copra," the sun-dried cocoa-nut. I landed after lunch, and Captain Hernsheim kindly placed a boat at my disposal, manned by about a dozen natives, in which I crossed to the mainland of New Britain, a distance of about two miles. The natives knew that I was in quest of butterflies, or "bembi's," as they called them, and professed to be able to take me to a spot where they said they were very plentiful. It was nearly three o'clock when we left Matupi, and about half-past when we landed upon the opposite side. At first we wandered through banana plantations, where butterflies were scarce, and I only captured a few *Danais sobrina*, Boisd., *Melanitis Leda*, L., &c., and, being anxious to fall in with the great *Ornithoptera*,

I told the natives to lead me to the "bush," where they were more likely to occur: they replied, "bush too far," but this was sheer nonsense, as I could see it not more than half a mile off. They are a lazy lot these natives of New Britain. However, at last we managed to get clear of the bananas and sugar-cane, and reached the edge of the forest, where we found that we had to ascend a gentle hill, the slopes of which were cut up into numerous gullies. The soil was everywhere very light and friable, and in many places pierced with holes resembling foxes earths. I asked what they were caused by, and was told "pigeon with big egg"; and presently one of the boys thrust his arm into one of these holes, and, after feeling about for a short time, brought out a pale buff-coloured egg, as large as a hen's egg. These holes, the home of the megapode, were very numerous, so there were evidently plenty of birds, though I did not see one upon this occasion. Walking on we came to a tree covered with attractive flowers, and here butterflies were common, but confined to two species of *Danais*, *Euplœa*, and *Papilio polydorus*, Linn., *Diadema alimena*, Linn., and a few *Lycænidæ*; but the flowers were mostly high and out of reach, and not many captures were made. A little farther on there was another tree with shining dark green leaves, and small white tubular flowers possessing the most exquisite perfume. When plucked a thick white sap exuded from the broken stem, which made me think it was some kind of india-rubber tree. Flying among the topmost boughs, and unfortunately out of reach, were several huge *Ornithoptera*, and I noticed that the males were golden green and black above, and not blue and black like those taken at Meoko the previous year. It was now getting pretty late, and the large butterflies seemed to be feeding in a very leisurely manner, as if they had finished for the day, and several of them settled among the branches apparently for the night. I was in despair and just moving off to another tree, when I saw a male alight upon a twig about twenty feet from the ground, and close to the trunk of the tree, where he evidently meant to take up his quarters for the night. I waited for a few minutes to allow him to compose himself, and then sent one of the natives up the tree with my net. The butterfly kept quite still as he ascended, although

the branches were so much shaken that I expected every moment to see it fly away. However, the naked native crawled nearer and nearer, until he was well within reach, when he made a clever stroke and caught it, and handed the net down to me. To my chagrin it proved to be a very mutilated and ragged specimen, and quite unfit for anything, so it was allowed its liberty. A few minutes after this I had a wild run over some rugged and open ground, after a huge female, which went flapping along like an owl just in front of me. I came up with her, and was on the point of making a stroke when I put my foot into one of the megapodes' holes, and fell heavily among the coarse sedgy grass. This gave the butterfly such an advantage that I did not resume the chase, and, as it was now getting late, we returned to the boat.

We remained at Matupi the whole of the next day, the men being employed coaling ship; so I determined to have a long hunt for *Ornithoptera*. One of my messmates (T.), hearing my account of the megapodes' holes, took his gun and accompanied me. We left the ship at nine o'clock, and, having borrowed a boat from Captain Hernsheim, with nine natives to pull and assist us, we soon reached the opposite side. We landed about three miles to the eastward of the point where we disembarked the day before, and within a short distance of a small active volcano, about three hundred feet high. As we neared the shore we noticed steam rising from the surface of the water, and many boiling springs could be seen bubbling up from the bottom, and the water near them was so hot we could scarcely bear our hands in it. Nothing grew within a hundred and fifty yards of the summit of the volcano, and its sides were deeply scored as if from lava action, and in many places jets of steam were issuing. Here and there there were large sulphur-yellow patches, and near its base, and not far from the shore, were numerous clumps of a peculiar bright sulphur-green grass, which were very conspicuous in contrast with the dark green forest foliage close at hand.

As soon as we landed we separated, my friend T. going one way with two or three natives to look for megapodes, while I, with the remaining natives, went in another direction in search of "bembi's." We agreed to keep as near as possible, and to "cooey" occasionally

to each other, so that we might not get too far apart, and might meet for lunch. Our path at first took us through dense jungle, where no collecting could be done, but in about a quarter of an hour we reached a part of the forest where the undergrowth was less thick, and where a few butterflies, *Euplææ* and *Hamadryas* sp.?, were taken. Pushing on we at length reached a ravine, through the centre of which it was evident a fierce torrent often ran. At the time of our visit it was almost dry, excepting a pool here and there, but the rest of the bed composed of smooth pebbles of various sizes. The banks were steep, the lower parts covered with a fringe of sedge and rough grass, above which were trees, bushes, and innumerable creepers. Here the magnificent metallic-blue and black-bordered *Papilio ulysses* was flying backwards and forwards in some numbers, but do what we could, neither myself nor the natives, whom I had provided with nets, succeeded in catching any. They flew very rapidly, and generally high out of reach, but occasionally one passed sufficiently near to afford, apparently, an easy shot, but somehow or another, just as I made a stroke at it, it swerved to one side with astonishing celerity. I was probably nervous at the sight of such a brilliant creature, and so missed it. Unfortunately there were no low-growing flowers to attract butterflies, but, on the other hand, there were two kinds of forest-trees from forty to sixty feet high, whose crowns were loaded with white blossom, and among which numberless butterflies could be seen disporting themselves, a sight which was most trying and tantalising.*

We wandered up the ravine for nearly a mile, catching Lepidoptera by the way, when suddenly, upon turning a corner, we saw, a short distance in front of us, that further progress was arrested by the face of a perpendicular cliff, some eighty feet high, and over which, during the rainy season, a magnificent waterfall must tumble. At the foot of the cliff, in the shade, were some pools of clear water, and, as it was now lunch-time, and

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* I have been informed by Mr. Miskin, of Brisbane, that he once took a number of *P. ulysses* in the north of Queensland, flying before the flowers of a kind of pumpkin, which seemed to be very attractive to them.

this was a comparatively cool spot, I thought it would be a good place to rest. T. was not heard shooting, nor did he reply to my "cooeys"; indeed, I doubt if we could have heard each other for any distance on account of my being so far below the level of the surrounding country.

While I was at lunch a large and almost perfectly white *Euplæa* (*E. Browni*, Salv. Godm.) floated high over head, to and fro across the ravine, in an airy, graceful manner. Altogether this was a most romantic and beautiful spot; the lofty cliff behind, fringed at its summit by a variety of strange tropical trees; the almost perpendicular walls on each side, clothed to their base with thick shrubs and a multitude of creepers; the ravine stretching in front of us for some hundred yards, where a sharp turning suddenly shuts it in; its centre strewn with large blocks of stone brought down by the mountain torrents; with tiny green patches here and there, their margins bright with sedgy grass, lovely ferns, and unknown and beautiful-leaved plants. A few yards from where I sat, upon a dead tree, six naked savages reclined on the sandy shingle in the bed of the stream eating the ship's biscuit I had given them, smoking their pipes, and rapidly chattering their uncouth language.

After lunch and half an hour's rest I thought it was time to be off again, and, as there was no possibility of climbing up the cliff, we had to retrace our steps down the ravine. When we reached the spot where we entered it in the morning we passed on and continued our way towards the sea. A few *Euplæa Treitschkei*, Boisd., *E. pumila*, Butl., *Cyrestis fratercula*, Salv. Godm., and some *Lycænidæ* and *Hesperidæ* went to swell the contents of the collecting-box, but so far no *Ornithoptera* had been seen. In a short time we came to the end of the ravine, into some open grassy land, which ran down to the water's edge, the forest trending gently away to the right and left. We had barely entered this likely-looking locality when there was a sudden shout from the natives behind me, one or two who could speak a little broken English exclaiming "Here big one," "Here big fellow." I turned round at once and looked up into the trees, but could see nothing: the natives redoubled their shouts, and I kept turning round and round and looking

upwards until I got quite confused. At last I thought of looking lower, and then, just passing me, but a little out of reach, was a splendid large female *Ornithoptera* flapping lazily along. It must have flown quite close to me, and had I seen it sooner I should probably have had an easy shot at it. I followed as it flew by the edge of the forest just ahead of me, and presently it turned and went right across the open grassy space, keeping rather high. We continued in pursuit, the natives crying "burrigee, burrigee, burrigee," which meant "come down, come down"; but, it is needless to say, this had no effect on the butterfly, which kept along steadily until it reached one of the high trees with white-scented blossoms, and here it stopped and began fluttering from flower to flower. This tree was growing upon a slight eminence upon the bank of a small dry water-course. Upon the opposite side were forest-trees, and an undergrowth of various shrubs, over which the *Aristolochia*, from which I took the larva of *O. urvilliana* at Meoko last year, was climbing luxuriantly. We sat down near the tree and watched, and in a short time one, two, three glorious black and green male *Ornithoptera* joined the female, and commenced flying above her and following her from flower to flower. I now kept on the alert, for I knew it was likely that these attentions would make her fly low. In a short time one of the males left the female, and began feeding by himself, descending towards the lower branches as he did so. My net was fastened to the end of two joints of a bamboo-rod, making the handle eight feet long. I waited beneath the branch until at last the butterfly settled upon the very lowest flower. Still it was not quite near enough, but it was my only chance, and I thought by jumping up and striking at it I might possibly just reach it. It was an anxious moment. I took a big jump, made the stroke, and, to my intense delight, netted the black and golden-green beauty. After this we crossed to the opposite bank, and sat down and watched the others, which were still flying and feeding among the topmost branches. Constantly looking up was somewhat fatiguing, so I rested on my back for a few moments and closed my eyes. Presently there was a shout, and, sitting up, I saw a large female settle on a small bush about two feet from the ground the other

side of the water-course, while a beautiful male hovered just above her. I gave my net to one of the natives, as I thought I could not scramble across quick enough, and told him to catch the "big fellow." Over he went, and crept up stealthily within two yards of them, made a deliberate stroke at the female as she sat upon the twig, and, to my intense disgust, missed her clean. I felt so mortified and so angry at having sent the savage instead of going myself, but I thought he would be much quicker, and was afraid the butterflies would fly away. Just after this misfortune T., with his natives, arrived on the scene with eight megapodes and various other birds, and we sat down and made a kind of afternoon tea of our remaining sandwiches and Australian wine. While so engaged I happened to look round, and there were two *Ornithoptera*, male and female, flying quite low in the scrub just behind us. I jumped up, seized my net, and ran towards them, tumbling over a stump in the way, but picked myself up again not much the worse. As I drew near I moved more cautiously, and was pleased to see the female alight upon a large *Aristolochia* leaf, while the male remained hovering about a yard above her. Advancing as quietly as possible I got within reach, made a stroke, and had her safely. It would have been dangerous to have attempted to catch both at the same time. This female was a very large and fine example, and quite perfect. After killing her I pinned her to a twig in a conspicuous place on the outskirts of the scrub, hoping that she would attract some of the males, but, after waiting in the shade for more than half an hour, and no males appearing, I boxed her, and we proceeded through the bush towards our boat. We had not walked far when I saw a beautiful pair of our friends flying slowly towards us, the male "toying" after the female. I stood quite still, and they flew right at me, and I successfully netted the female. She was quite perfect. Soon after this we noticed another pair in the scrub, but they were in a difficult place to get at; so I sent a native after them, with instructions to capture the male if possible, for I noticed that the female was torn. He got quite near them, and was lucky enough to secure the male, which proved to be a fine fresh specimen. It was about four o'clock when this last *Ornithoptera* was taken; so it appears

that the afternoon is the best time of the day to obtain them. It was now getting late, and, as we were close to our boat, we embarked and returned to the ship, well pleased with our day's sport.

Although *Ornithoptera*, as a rule, fly high, the larvæ are generally found within easy reach. At Meoko, Duke of York Islands, I found full-grown and small larvæ of *O. durvilliana* within six feet of the ground, and empty pupæ-cases within two feet; and at Thursday Island, in Torres Straits, larvæ of *O. pronomus* were taken feeding upon trailing shoots of *Aristolochia* within a few inches of the ground (one of them was nearly trodden upon), while pupæ were taken from four to six feet from the ground.

Ornithoptera pronomus, Gray.

Length of full-grown larva from 58 to 64 mm., tapering towards each extremity; central segments much thickened; smoky black, some with a tinge of madder-purple; head black and shining, with a narrow white V-shaped mark on the face; upon the crown of the second segment a triangular-shaped shining black plate, just before which is the transverse nuchal aperture, from whence, when the larva is annoyed, a pair of short, thick, fleshy, carmine tentacles are protruded; a subdorsal row of rather long and finely-pointed spines, those on the posterior segments pointing backwards; tips and base black, intermediate parts carmine; the spine on the eighth segment is white at base with black tip, and pink in the middle, and with its base produced into a broad white oblique stripe pointing forwards, and terminating at the spiracular region; a row of black spines just below the spiracles; upon the third, fourth, and fifth segments an additional spine between the subdorsal and spiracular row; a short, black, blunt tubercle upon the second segment on each side of the face; a short black spine above each clasper and legs; claspers and legs shining black.

The chrysalis, which is of an amber-brown colour, is slightly angulated; a pair of blunt, subdorsal, black-tipped spines upon each side of the abdominal segments, and some small black spines upon the back of the thorax: a large and almost triangular-shaped orange-yellow blotch upon back of anterior abdominal segments;

wing-sheaths dark reddish brown, with the nervures well-marked.

Weight of larva $164\frac{1}{16}$ grains, of chrysalis $82\frac{1}{32}$ grains.

Ornithoptera urvilliana, Guér. (Pl. VI., fig. 1).

Length of full-grown larva from 55 to 60 mm.; comparatively short and obese; tapering towards each extremity; central segments much thickened; velvety black; head shining black; second segment crowned with a triangular black shining plate through a transverse slit, in which, when the larva is irritated, it protrudes two rather short, blunt, carmine, nuchal tentacles; a subdorsal row of eleven fleshy spines, black at their base and tips, and carmine between, except upon the eighth segment, where the base of the spine is pure white and runs into an oblique white stripe a little beyond the spiracular region; upon the third, fourth, and fifth segments there are intermediate spines of the same colour; a subspiracular row of black spines curved upwards; spiracles small, pale yellowish white; legs and prolegs black.

Chrysalis does not differ from that of preceding species.

Papilio erithonius, Cram.

This species appears to be rare in the neighbourhood of Sydney. I only saw it once, on September 27th, 1882, in the Botanical Gardens, settled on a verbena, and failed to catch it. On December 13th I met with it commonly in the Botanical Gardens at Brisbane, but it was then passing. In November and December, 1884, it was abundant at Port Moresby, New Guinea, and I found larvæ of all sizes feeding exposed upon a species of *Salvia*, and bred a fine series. It was not uncommon at Thursday Island, in the Torres Straits, at the end of April, 1885.

It is a rapid-flying butterfly, but is not difficult to catch when it is engaged fluttering among the *Salvia* bushes. It is also fond of settling by the margins of dirty puddles. The egg, which is perfectly globular and pale straw-colour, is deposited upon the upper surface of the leaves. The young larva is black, with a shining black head, and clothed with minute black spines. After

the first moult a few small orange blotches appear upon the back. The half-grown larva is very handsomely mottled with orange, yellow, and reddish brown and black. When it is full-grown it is 40 mm. long, with the third, fourth, and fifth segments rather thickened; ground colour sage-green, faintly tinged with yellow; a series of small pale yellow spots on each side of the dorsal line, and immediately below, and a little in front of them, a subdorsal row of spots of the same colour, but slightly larger; these spots on the fourth segment form a short transverse stripe; spiracles minute, pale yellow, enclosed in a black ring; just below the spiracles, from fifth to seventh segments, a small orange-red spot; lateral skinfold well-developed, creamy white, and forming a conspicuous stripe; anal flap, claspers, and ventral surface pale greenish white; head bluish green, with a treble series of light-coloured V-shaped markings on the face; a small black orange-tipped tubercle upon each side of the second segment just behind the head, and two of the same colour upon the thirteenth segment just above the anal flap; segmental divisions well-defined; nuchal tentacles rather short, thick, and salmon-coloured.

When full-grown the larva attaches itself to a stem of its food-plant, and changes to a rather slender and slightly angulated chrysalis of a pale greenish yellow colour.

At Port Moresby the butterfly frequented open waste places on hill-sides facing the sea. I never met with it in the forest.

Papilio indicatus, Butl. (Pl. VI., figs. 3, 3 (*a*), & 3 (*b*)).

I met with this rather commonly at Thursday Island, in Torres Straits, in April, 1885. At Port Moresby, in New Guinea, it was one of the most abundant species during our visit in November, 1884, and I succeeded in finding the larvæ and breeding a good series. One day while we were at anchor (we were nearly two miles from the landing place), a constant stream of butterflies passed the ship, flying across the harbour from south-east to north-west, the harbour being from three to four miles wide. Many thousands must have passed during the day, and three-fifths of them consisted of this species,

the others being different kinds of *Pieris*, *Euplœa*, *Libythea*, *Lycæna*, &c.

These butterflies were usually to be found in the forest, flying among the undergrowth. They were not difficult to catch, though perfect specimens were rarely obtained. I discovered the larvæ by watching a female which was slowly flitting from bush to bush, as if she was looking for the right one on which to deposit her eggs, and presently saw her settle upon a twig and thrust her abdomen beneath a leaf, and when she flew away I walked up and found the egg. The shrub was some species of *Citrus*. After this I had no difficulty in finding larvæ of all sizes.

The egg is deposited upon the upper or under surface of the leaf, the parent butterfly not being particular in this respect. It is perfectly globular, pale yellow when freshly laid, but changes to pinkish brown before the larva emerges. Young larva pale olive-green; anterior and posterior segments, and spines over the head, and over anal flap, white; a broad V-shaped mark on centre of back; a row of small, subdorsal, white spines; head shining black; anal flap dark olive-brown.

Full-grown larva 33 to 35 mm. long; rather slender; third, fourth, and fifth segments much thickened, with a blunt, fleshy spine on each side of the dorsal line, those on thirteenth segment much the largest and pointing backwards over anal flap; general colour beautiful mottled olive-green and reddish brown; an oblique, creamy white blotch commencing from, and enclosing, spiracle on fifth segment, and extending upwards to seventh segment, terminates just below dorsal line; an irregular-shaped blotch of the same colour on side of second, twelfth, and thirteenth segments; head pale greenish brown, with paler V-shaped mark over mouth; nuchal plate, and short blunt spines behind head, orange; nuchal tentacles deep carmine; spiracles very small, orange, in a black ring; lateral skinfold, and segmental divisions, well defined; a creamy white stripe below spiracles; ventral surface and claspers dull greenish, or greenish white; a raised bluish white dot on each side of the dorsal line upon fourth, fifth, and tenth segments; legs greenish.

These larvæ are extremely difficult to describe, scarcely any two of them being alike. Mottled olive-greens and

yellows and orange-browns and reds predominating. A common variety was of a uniform pale apple-green, mottled with lighter and darker shades, and with only a faint indication of the oblique stripe from back of head to crown of fifth segment, and stripe above spiracles clear greenish white, with the under surface and claspers slightly paler.

When full-grown the larva attaches itself in the usual manner to the stem of its food-plant, and changes to a dark, shining, apple-green chrysalis. Its back is rather humped, and head strongly bifid, a pale reddish brown stripe runs along costal edge of wing-case, and side of abdomen, to anal extremity: a row of dark green spots on each side of the ventral line, and another row of five spots on each side of these, nearer the median line. The butterflies emerged in about three weeks.

Papilio erectheus, Don.

This fine butterfly was tolerably plentiful at Sydney, especially in the neighbourhood of orange orchards. It is a very conspicuous species on the wing, and I shall not readily forget the first time I saw it careering down one of the streets of Paramatta, when I was on my way to visit the celebrated orange orchards, a few days after our arrival at Sydney, in May, 1882. It has an irregular style of flight, and, although so large, is anything but an easy butterfly to capture, and, when frightened, it goes off at a headlong pace. The sexes differ in a great degree in size, colour, and markings. The females were often to be observed fluttering among the lower branches of the orange trees, seeking for a suitable leaf upon which to deposit their ova. Different females acted differently in this respect; some flew up to the bush with a rush, and deposited their egg upon the first leaf that presented itself. These were the fresh inexperienced young females eager to lay their first eggs; the more sober and tattered ones expended a lot of time flitting from branch to branch before they could find a leaf to their liking, and then usually selected one growing from a sucker close to the main stem of the tree. While so employed they were quite fearless and easy to catch, and upon several occasions when I had no net with me I have taken them between my finger and thumb.

The egg is in most cases placed on the underside of the leaf, near its edge, though in several instances I noticed them upon the upper surface, or upon the terminal shoots. It is moderately large, and perfectly smooth and globular, and when freshly laid is pale straw colour. By the fourth day it has become of a darker hue, and a dusky shade begins to appear on one side, and this gradually deepens until by the ninth or tenth day it is almost black, the remaining portion of the egg assuming different shades of French gray. With a pocket-lens the young larva can be faintly seen within the shell. On the tenth day the larva emerges, and for a short time remains perfectly motionless as if to recover its strength after the exertion of gnawing its way to the outer world. When it has sufficiently rested, it turns round and deliberately devours the remains of its shell. It then wanders about for a little while, but does not often quit the leaf upon which it was born; but when it has satisfied itself with its examination it spins a little pad of silk on which to secure a firmer foot-hold; from this it proceeds to the edge of the leaf, where it nibbles its first repast, and this it continues to do as often as it is hungry, crawling backwards and forwards from its silken pad to the margin of the leaf.

When first hatched the young larva is about 3 mm. long; black, with the exception of the dorsal portions of the second, third, sixth, seventh, twelfth and thirteenth segments, which are white; head shining black. The whole larva seems to be covered with fine hairs, but, upon being viewed through a lens, these appear to be minute fleshy spines, though there are undoubtedly fine hairs interspersed amongst them. The third and fourth segments are considerably thickened.

The full-grown larva is 62 mm. long, somewhat cylindrical, and with the fourth and fifth segments considerably thickened. It is soft and flabby to the touch. Upper surface pale green, or greenish olive, mottled and streaked with darker shades of green; this ground colour, upon approaching the spiracular region, becomes of a golden, or golden-olive hue; a deep madder-brown stripe runs from the mouth below the spiracles to the fifth segment, when it turns obliquely upwards, and passes over the back, forming a broad conspicuous ring, the posterior part of which is of a deeper and more velvety shade

than the anterior; this stripe is also dotted and streaked with white; an oblique stripe of the same colour springs from the spiracular region of the eighth segment, and runs into the ninth segment, as far as the base of the subdorsal spine; a triangular blotch of the same hue on the tenth segment; these stripes, besides being dotted, are more more or less bordered with white; there are some conspicuous black dots upon the lower part of the thirteenth segment, and a smoky V-shaped mark upon the anal flap; there is a subdorsal row of blunt fleshy spines, orange, except upon the ninth, tenth, and eleventh segments, where they are black; upon third, fourth, and fifth segments there are additional spines below the subdorsal row, and some minute fleshy points near the dorsal line; head smoky black, with a white V-shaped mark upon the face; legs smoky; prolegs, subspiracular and ventral area, from seventh segment to anal claspers, glossy white.

When irritated these larvæ have the power of emitting two long carmine-coloured nuchal tentacles from a transverse, valve-like aperture, situated upon the crown of the second segment, just behind the head, and while the tentacles are exposed a disagreable odour of rotten oranges is distinctly perceptible. The larvæ feed only by day, remaining perfectly quiescent throughout the night.

When within a couple of days of being full-grown it loses its power of exhibiting the carmine tentacles, but if annoyed, sways itself from side to side with a tremulous motion. Upon becoming full-grown it ceases to feed, remains in one position for several hours, and voids the contents of its intestinal canal, the "frass" becoming more and more liquified, until the larva finally passes a few drops of a clear, greenish, oil-like fluid. Shortly after this it commences to wander about searching for a suitable place to fix itself for its next change, and when it has chosen a spot it again remains quiet for an hour or two, and then begins to spin silk up and down the branch it has selected, taking care to lay it on thickest at the point which is to receive the terminal hooks of the chrysalis. The last thing it does is to spin the thread which girts the chrysalis, and this appears to be composed of a stronger material than that which is used for covering the branch with, although it may possibly be several threads united (as I know is the

case with the larger *Ornithoptera*). After this is accomplished it remains quiet, but jerks itself rapidly from side to side when any other larva approaches it, or it is otherwise annoyed, and its movements are often so violent that it is astonishing that the silken girdle does not break.

At seven o'clock one morning I observed a larva writhing and contorting itself in a remarkable manner. It was evidently on the point of changing, so I watched it carefully. The movements consisted of a series of whirling upward motions, and presently the head of the larva split transversely across the face, and the soft green tip of the chrysalis became visible. The rest of the change was effected with great rapidity, the whirling and pushing motion being continued without intermission, until the old larva skin had slipped down as far as the anal claspers, when the end of the chrysalis was suddenly withdrawn, and the old skin fell to the ground, the chrysalis meanwhile being supported by the silken girdle alone. The abdominal segments were then moved rapidly from side to side, the creature appearing to be searching for the silken pad into which to thrust the minute hooks at its extremity. When this was found the anterior part of the chrysalis was lowered as far as possible, and the whole curved upwards, bringing the tip almost at right angles to the orange stem. In this position the abdomen was quickly and vigorously whirled round and round as if the creature was endeavouring to screw the points into the silk, and in a few moments, this being accomplished, the chrysalis rested from its labours, only now and then giving a spasmodic jerk. The whole process of changing took seven minutes. At first the chrysalis looked soft and unshapely, but in an hour's time it had hardened, and assumed its ordinary form and angles. It was then 37 mm. long, of a beautiful green, the exact colour of the stem to which it was attached. Head strongly bifid; back arched; sheath of haustellum and base of wings prominent; there is a depression between base and anal angle of wing, which runs round the upper portion of the abdomen, and gives the chrysalis a constricted appearance; spiracular region strongly ridged; a silvery white and somewhat interrupted stripe runs from the base of the wings to the abdomen, and the lower part of the abdomen is suffused

with the same colour; upper portion of abdomen a beautiful golden greenish hue with two small red dots on each side. These chrysalids vary excessively, scarcely any two of them being alike, for they have the power of assuming the colour of the object to, or against, which they may be attached, and I have had them of all shades of green, brown, reddish brown, rosy, &c.

A larva hatched on October 29th changed to a chrysalis on November 17th, but as a rule they were generally a week longer in the larva state. Larvæ found from September to February produce imagos in a few weeks, but those taken in March, in most cases, remain in the chrysalis state until the following August or September. The larvæ do not appear to suffer from the attacks of ichneumons, or any other parasite, for no instance came under my notice. In all their stages the larvæ feed perfectly exposed, and the young ones bear a strong resemblance to a bird's droppings. This, of course, is more or less protective, but nevertheless they are kept well in check by a pretty little olive-green bird with white eyelids (*Zosterops cærulescens*, Lath.), numbers of which frequent the orange orchards and hunt among the trees in a very sprightly manner, having habits similar to those of our familiar chiffchaff. I have seen a tree with young larvæ upon every branch, and a few days after they had all disappeared. If it was not for this little bird I have no doubt this butterfly would cause an immense amount of mischief to the orange trees.

P. erectheus may be seen almost any day in the neighbourhood of Sydney between August and May, but during the two mid-winter months it is in the chrysalis state. I have taken it at Brisbane, and Cooktown, in the north of Queensland, in December, and at Thursday Island, in Torres Straits, in April; and it was not uncommon in the southern parts of New Guinea in November, 1884. All the butterflies I bred emerged between 5 and 9 a.m.

Papilio Anactus, Macl. (Pl. VI., fig. 2).

This species is generally distributed in the neighbourhood of Sydney, but I found it by no means common between 1882—84, and did not see more than half a dozen in the perfect state each year. It occurs in

orange-orchards, upon which tree the larvæ feed. It is a weak insect on the wing, and mimics *Acræa Andromacha* both in its general appearance and mode of flight. It appears from October to March, and, like *P. erectheus*, there is a succession of broods throughout the summer.

The eggs are deposited on the tender leaves of the orange, generally upon the under side near the edge. They are perfectly globular, flattened beneath, and pale straw-colour. The young larva is very similar to that of *P. erectheus*, but when full-grown it is quite different. It is then 37 to 39 mm. long, somewhat short and stout, cylindrical, and tapers slightly towards the head. The whole surface deep blue-black, irregularly spotted with minute white and bluish dots; a dorsal row of rather large heart-shaped yellow spots; a subdorsal row of large yellow spots, irregular in size and shape, with the exception of that on the fifth segment, which is round and very small; a subspiracular row of pale yellow linear-shaped spots from fifth to twelfth segments; legs smoky black, the foremost pair with an orange spot at their base; prolegs and ventral area brownish orange; head black, with a faint V-shaped mark on the face; a subdorsal row of short, blunt, black spines. When irritated this larva has the power of protruding a fleshy, bifid, orange-coloured tentacle from the nuchal aperture, upon the crown of the second segment just behind the head, at the same time emitting an unpleasant perfume of rotten oranges.

Two small larvæ, taken October 18th, 1882, attached themselves to the stem of their food-plant on the evening of November 4th, changed to chrysalids during the night of the 6th, and on the 16th of the same month, at 8 a.m., two beautiful butterflies emerged. Before attaching themselves these larvæ voided a quantity of frass and fluid-matter, and shrunk to about half their natural size, and I was afraid some disease had attacked them.

Papilio Lycaon, Westw.

This elegant butterfly is not uncommon in the neighbourhood of Sydney, and I have met with it at Newcastle, Cooktown, Thursday Island, and the south-eastern coast of New Guinea. It is more frequent some years than others. It appears from November to February.

It flies rapidly and generally high amongst the topmost boughs of trees, but descends occasionally to feed upon the nectar of various flowers, and is especially fond of those of the abundant "lantana."

Early in January, 1885, I noticed a female depositing her eggs upon leaves of the topmost branches of a cherrymoyer tree in the Botanical Gardens, and on February 21st, upon passing the same tree, I discovered a few small larvæ on the lower branches, and subsequently took larvæ and ova from other trees elsewhere.

The egg is usually deposited on the under side of a leaf, a favourite position being close to the edge near the stalk, though it is sometimes placed upon the upper surface. It is globular, and when fresh pale straw-colour, but in a few days it turns to deep orange, and shortly before the larva emerges it becomes a leaden hue. The larvæ in all their stages feed perfectly exposed upon the upper surface of the leaves.

Larva just hatched dark umber-brown; anal spines white; head brownish black, shining; anterior segments thickened. After first moult it becomes deep blackish brown; anterior segments much the darkest and considerably thickened, giving the larva a humped appearance; a pair of finely branched spines project over the head, and there is a pair upon the third, fourth, and thirteenth segments, and a pair of conspicuous white spines project over the anal flap; head black and shining. After second moult larva remains much the same. After third moult the whole of the upper surface becomes deep velvety black, inclining to madder-purple in some individuals, the segmental divisions, as the larva crawls, much paler; anal and ventral claspers, and a narrow stripe above them, creamy white; head sienna-brown, shining; anterior portions much thickened.

Full-grown larva 35 mm. long; varies in colour, some being dirty olive-brown, others greenish olive, and others deep madder-brown; dorsal area darker than general ground colour; segmental divisions pale smoky brown and clearly defined; head pale greenish olive; a white stripe below the spiracles from the fifth to the anal segment; third and fourth segments considerably thickened; two short, blunt, black spines springing from a pale greenish-orange collar, just behind the head, and situated on each side of the nuchal aperture; nuchal

tentacles short, curved, fleshy, and pale straw-yellow; on fourth segment a short, blunt, black, subdorsal spine, situated in a minute orange ring; anal segment produced, and with a pair of divergent spines at the extremity, the spines yellowish white above, but black beneath; there are a few short pale hairs on the head and under surface, especially at base of anal and ventral claspers; under surface and legs smoky; spiracles minute, whitish, in a darker ring. When full-fed the larva, having previously fastened the stalk of the leaf to the stem with several layers of silk, attaches itself to its upper surface and changes to a dark green chrysalis with a conspicuously-pointed thorax.

The young larvæ are eagerly devoured by the little White Eyes (*Zosterops cærulescens*, Lath.). I passed a cherrymoyer-tree one morning, and noticed numbers of small larvæ of *Lycaon* upon the lower leaves, and a few days after I went there for the purpose of taking some of them, but could not find one, these little birds having cleared them all off.

Pamphila phineus, Cram.

This skipper was common at Sydney in the Botanical Gardens, and in other gardens where palms were cultivated, but I did not meet with it in the bush. It flies very rapidly, and, after the manner of most Hesperids, is fond of taking up a position at the extremity of some exposed branch, from whence it darts forth and gives battle to every passing insect, returning after each encounter to the same spot, and in consequence of this pugnacious habit it is seldom to be taken in good condition. The females are rarely seen—indeed, I do not remember to have observed more than half a dozen: one I captured, another was noticed depositing its eggs, and the others were sitting, out of reach, upon the upper leaves of palms. There appears to be a succession of broods from spring to autumn, but during the winter months the larvæ, which are then small, hybernate between leaflets of palms, drawing the edges of the leaves securely together.

The egg is deposited on the under side of the leaf. It is perfectly globular, shining, and pale greenish yellow. As soon as the young larva is hatched it crawls to the

extremity of the leaflet, which generally rests upon or overlaps another, spins the edges of the two together, and so forms a little tent, from which it issues forth from time to time to feed, usually eating the leaflet from its tip towards the base. As it increases in size it forms a larger domicile, fastening the edges of the leaves together by little cables of united strands of white silk fixed to pads of silk placed about half an inch apart.

The full-grown larva is 40 mm. long, cylindrical, rather elongate and depressed, and tapering towards the head; head considerably larger than the second segment, flattened and porrected, and somewhat cordate, light pinkish grey, with black margins to face and a V-shaped mark in centre, and with a longitudinal black mark between mouth and base of V; general colour of larva transparent slaty greenish grey, anterior and posterior segments rather paler; a darker pulsating dorsal vessel; upon the tenth segment there are two golden-yellow spots, lying just beneath the skin, and showing through on each side of the dorsal vessel (these spots are caused by some internal organs); anal segments sparsely clothed with fine white bristles; spiracles pale yellow; whole surface more or less finely and transversely wrinkled; lateral skinfold well-developed. Just before its final change it assumes a bluish green or leaden hue. When full-grown it spins the edges of the leaves more firmly together, constructs a light silken cocoon, and therein changes to a pale reddish-brown chrysalis, which is thickly powdered with a whitish-purple bloom. This powder exudes from beneath the ninth, tenth, and eleventh segments of the larva as it lies quiescent preparatory to its next change. The chrysalis, which is at first somewhat transparent and pale greenish yellow, is from 25 to 30 mm. long, cylindrical, and tapers towards anal extremity; thorax much broader; head and eyes prominent; thinly clad with short pale reddish-brown and slightly-curved bristles, those upon the head and thorax pointing forwards, while those upon the abdomen point backwards; just above and behind the eyes, upon the suture dividing the head from the thorax, there is a conspicuous oval reddish-brown tubercle; the sheath of the haustellum extends beyond the wing-cases as far as the base of the eleventh segment, and is faintly tinged with rosy. A day or two before the insect emerges the

chrysalis changes to a deep reddish brown, and just before disclosure the markings of the wings are plainly visible.

The larvæ feed on various kinds of palms, *Kentia Fosteriana* (a native of Lord Howe's Island), *Seaforthia elegans*, *Arica sapida*, *Phœnix reclinata*, different species of *Chamærops*, &c., and they feed only at night. I also met with this butterfly in the Botanical Gardens, Brisbane, at Thursday Island, and the Duke of York Islands.

Pamphila angustula, H.-S.

This species was very common at Fiji. The males were far more numerous than the females. It occurred in paths through the forest, in sugar plantations, and wherever there was plenty of coarse grass or sedge, upon which, as well as upon sugar-cane, the larvæ feed.

The full-grown larva is from 28 to 30 mm. long, rather slender, cylindrical, and tapers towards each extremity; head smaller than the second segment, subcordate, somewhat porrected, dull greenish olive, and very minutely punctured; ocelli black; general colour pale yellowish green inclining to whitish; dorsal, subdorsal, and a series of lateral lines dull greenish blue; ventral area darker; spiracles very minute, yellowish; legs and claspers pale greenish; most of the segments, particularly the second, third, and fourth, more or less transversely wrinkled. It feeds between the united leaves of various coarse grasses and sugar-cane, and when full-grown fastens the blades more firmly together, sometimes closing both ends with a fine web; within this it spins a pad of silk for the reception of the anal hooks, encircles its anterior segments with a thread, and then undergoes its change.

The chrysalis is somewhat elongate and tapers slightly towards the anal extremity. The head has a conspicuously pointed and rather curved rostrum, the eyes are prominent, and the thoracic segments well-defined; general colour pale grass-green, with two whitish dorsal abdominal lines; tip of rostrum and anal point slightly rosy.

Netrocoryne repanda, Feld. (Pl. VI., fig. 5).

This butterfly occurs in several localities near Sydney, but does not appear to be very common. It flies rather

rapidly, and occasionally extends its wings rigidly and soars for a short distance, something after the fashion of *Neptis* or *Limenitis*, and when it alights, which it does very abruptly, it usually selects the under part of a leaf, where it rests with its wings widely expanded and appressed. On September 13th, 1884, I found several larvæ of this Hesperid in cocoons composed of a single leaf of a species of *Eugenia*. The leaf selected for the cocoon was doubled over upon itself, and the edges brought together until it formed a completely sheltered tent, having a round opening, evidently gnawed afterwards, facing the stalk, which was strongly fastened by silk to the branch. The leaves forming these cocoons had perished and turned to bright reddish brown, so were conspicuous objects among the green leaves of the tree. These larvæ were small, and so were probably still hybernating. On October 9th I met with more of them, and they were much larger than those found on September 13th, one or two appearing to be nearly full-grown, but I failed to rear any, as it was difficult to keep their food fresh. Moreover, the 'Espiègle' left Sydney on October 19th for New Guinea, so my observations for the time were necessarily brought to a conclusion. On December 13th we returned again, but I was unable to visit the tree until the 27th, when I found several cocoons containing empty chrysalids, and one with a full one, which from its appearance seemed to be on the point of emerging, and the next day produced a butterfly.

The full-grown larva is somewhat short and obese in comparison with known larvæ of other species of Australian *Hesperidæ*. Head ovate-cordate, dull smoky black, considerably larger than second and third segments; face divided by a suture down the middle, and with a depressed V-shaped mark above the mouth; cheeks somewhat swollen; second and third segments bright gamboge-yellow, the second segment being transversely streaked with green; a small black spot upon each side of the dorsal line, and a large black spot just above the spiracles on the third segment; dorsal area of fourth to eleventh segments smoky black, with a double grey dorsal line widening out upon seventh and eighth segments, and diminishing towards the eleventh; a broad pale grey subdorsal stripe from fourth to tenth segments, below which is a broad black stripe to eleventh

segment, where it runs up to the dorsal line and forms a transverse black band; below this there is a narrow stripe of gamboge-yellow, and in this the spiracles, which are small and black, are seated, and below this again there is a narrow pale whitish-grey stripe; twelfth and thirteenth segments gamboge-yellow, the twelfth with a narrow black dorsal line, with a black dot on each side; a black triangular spot just above the spiracles; on thirteenth segment a transverse longitudinal blotch upon the back, and two black dots above the spiracles; anal flap dull olive-green; ventral area and claspers greenish olive; legs the same colour, with smoky-black claws.

The chrysalis is enclosed in a cocoon of fine silk spun within the leaf-dwelling; it is short and rather obese, with the wing-sheaths strongly developed. Colour warm reddish brown; eyes darker and rather prominent; abdomen covered with a greyish powdery bloom. It is attached by the anal extremity, and is encircled by a silken girdle. The larvæ feed only by night.

Trapezites symmomus, Hübn.

This is one of the largest of the Australian Hesperids, and occurs in many localities in the neighbourhood of Sydney, is somewhat local, and nowhere very abundant. It appears to be found more frequently near the sea than inland, and some of its favourite habitats are the wooded headlands in the vicinity of Botany Bay. Its flight is extremely rapid, and it is difficult to catch, as it takes alarm at the least movement, although, like most of the family, it usually returns to the same spot after it has been disturbed, and can be secured by patient waiting.[1]

It was some time before I made the acquaintance of the larva of this butterfly, although I had long suspected that they fed upon *Cladium* (?), for they were only to be met with where it occurred, and the plants, which grow in dense clumps, were always more or less eaten. But

[1] I always box *Hesperidæ*, for they flutter about so in the net that it is almost impossible to "nip" them in the ordinary manner, at any rate not without the risk of spoiling them. But they must be chloroformed and pinned at once, or they will batter themselves to pieces in the box in a very short time. I always carry a small bottle of chloroform for the purpose.

many a hunt for the larva was unavailing, and at last I almost came to the conclusion that they must feed upon something else, and that the eaten leaves were due to *Orthoptera*, which, in Australia, seem to devour anything green. However, one day in September, 1884, after a long and weary search, I discovered two old cocoons containing fragments of pupa-skins, but could find no larvæ. This was partial success, for it showed me I was on the right track, and stimulated me to renew my exertions on the occasion of my next visit to the locality on October 3rd. On this day I had another long hunt, and was just on the point of giving it up in despair when suddenly, to my great delight, I saw a large, plump, and full-grown larva ensconced low down among the stems of the plant, almost at the roots. After this I found a half-grown larva and several smaller ones, the latter being in little white silken cocoons spun up in the concave side of a leaf, about half-way down the stem. These, I fancy, were hybernating, although it seemed strange that some should be feeding while the others were quiescent. Others, too, must have been in the pupa state and ready to emerge, for I saw a fresh butterfly sitting upon a twig in the neighbourhood of its food-plant, but it darted off before I was able to secure it. There is a succession of broods, for I subsequently took many larvæ at different times of the year, and succeeded in rearing several of the perfect insects. In confinement they fed entirely by night, hiding by day low down among the stems of their food-plant. They grow very slowly.

On February 28th, 1885, I watched a female as she was engaged laying her eggs. She did not seem at all particular where she deposited them. The first was placed on the stem of the food-plant, about half-way down, the second upon a dead stem of the food-plant, the third upon a small twig near the root of the food-plant, the fourth upon a log of wood some distance off, the fifth upon a piece of dead fern, and the sixth upon a dried bent. She then flew away. The young larva in most of these cases would have to wander for some distance to find its food. The egg, which is large in comparison to the size of the butterfly, is perfectly smooth, globular, and pale greenish yellow.

The full-grown larva is 40 mm. long and very plump;

head subquadrate, the posterior angles rounded off; a well-defined groove down the centre of the face, branching off at the middle, and forming a Λ-shaped mark above the mouth; outer edge of groove bordered by a broad ochreous-yellow line, which is again bordered by a shade composed of minute black dots; crown, back of head to junction with second segment and outer margin of face thickly mottled with black dots; general colour warm pinkish brown, thickly irrorated with minute raised dots and longitudinal markings of neutral tint; a narrow and somewhat interrupted dorsal line, on each side of which a moderately broad but somewhat indistinct stripe composed of minute black dots, being most perceptible on third to sixth segments; spiracles minute, black, and just below them a rather waved stripe of neutral tint; ventral surface, legs, and claspers smoky; the three posterior segments more or less tinged with dull olive-green; the segmental divisions, as the larva crawls, are conspicuously pink.

The young larvæ are similar in appearance to the full-grown ones, but the markings are somewhat less distinct, and the general colour is paler, and varies from warm pinkish brown to pinkish ochreous. When full-grown the larva constructs a loose open cocoon among the lower stems of its food-plant, and changes to a stoutish pupa from 25 to 28 mm. long, light reddish brown, thickly and minutely dotted with black, and covered with patches of powdery bloom; wing-cases paler; eyes prominent, dark reddish brown, and just behind and above them a small nuchal aperture, encircled by pale reddish brown; anal point well-developed, curved towards tip, dark brown.

Hesperilla picta, Leach. (Pl. VI, figs. 9 and 9 (*a*)).

This beautiful skipper occurs sparingly in the neighbourhood of Sydney, but is only to be found in the vicinity of its food-plant, *Cladium mariscus*, and consequently is somewhat local. I first met with it on November 3rd, 1883, while I was gathering some food for larvæ of *Epinephele abeona*, when I noticed some tips of the young shoots of *Cladium* spun together, and upon examining and opening them discovered the empty chrysalis of a Hesperid. I at once set to work and

looked for more, and, as there were only a few plants of *Cladium* growing in this locality, I was not long in doing so. The result of my search rewarded me with three more empty chrysalids and a full one, the latter evidently just on the point of hatching, as the wing-markings were plainly visible through the case, and the abdominal segments were much swollen. The larva which produced this chrysalis had spun the tips of the leaves together just in front of another chrysalis, completely imprisoning it, for when the lower one attempted to emerge it found its way blocked, and so perished miserably, and its remains were being devoured by some red ants, who had worked their way in through the lower end of the first cocoon. I fancy such a mistake as this does not often happen in nature. The next day the upper chrysalis produced a fine female, and, as I had not seen the species before, I was much pleased.

A few days after this I was again in the same locality for fresh food, but had no net with me, and so, as a matter of course, saw several *picta* flitting about among the *Cladium*. There were two males and a female. The former frequently darted off and regaled themselves on the flowers of a neighbouring lantana bush, but the latter, I observed, was assiduously fluttering among the lower stems of the *Cladium*, and, after watching her for a short time, I came to the conclusion that she was depositing eggs, and presently I saw her do so, and secured the egg. I subsequently obtained this butterfly in several other localities near Sydney, took many chrysalids and larvæ, and bred a nice series of them. There are a succession of broods from spring to autumn, and during the winter months the small larvæ hybernate low down among the stems of their food-plant in loose silken cocoons.

The egg is deposited on the under side of the leaf, generally near its tip. It is somewhat orange-shaped, flattened at the base, and with a minute depression at the apex, and is finely ribbed, the ribs widening from apex to base. At first it is clear straw-yellow, changing to greenish yellow on the second day. About the sixth day an apical purple blotch and a waved purple stripe appears round the middle of the egg, and the whole turns to a dull lead-colour shortly before the emergence of the larva. The newly-hatched larva is pale yellowish green,

with purple dorsal, subdorsal, and spiracular lines; second and third segments greener than the others; when the little larva crawls or stretches itself the divisions between the head and second segment are conspicuously reddish, and there is a small shining plate upon the second segment just behind the head; a few scattered hairs or fine bristles upon the two posterior segments; head black and shining.

The full-grown larva has the head considerably larger than the second and third segments, somewhat cordate in shape and clear sienna-red; the crown, a double line down the centre of the face, terminating in a small V-shaped mark, of a much darker red; general colour pale transparent olive or greenish yellow, the green or yellow being brighter in some individuals than in others; segmental divisions clearly defined and white; dorsal stripe dark green, pulsating, bordered by a faint white line; irregular internal deep green pulsating blotches on each side of dorsal stripe; subdorsal line white and conspicuous; twelfth and thirteenth segments suffused with a bright rosy tinge; a faint waved yellow line below the spiracles, which are of the same colour; ventral surface slightly paler.

When full-grown the larva spins two or three of the terminal shoots of the *Cladium* together, and forms a cocoon of fine white silk, within which it changes to a pale greenish-yellow chrysalis suffused with a bluish white bloom; head strongly bifid, bifid tips nearly black; eyes and segmental divisions pale reddish; at base of wing-case a dark reddish brown crescent-shaped spot. Shortly before the butterfly is disclosed the chrysalis becomes a deep reddish brown, and the spots on the wings can be plainly seen through the wing-cases. The larvæ feed by night, and during the day are to be found hiding away at the base of the leaves.

Hesperilla ornata, Leach

The habits of this species are identical with those of *H. picta*, and the larvæ are very similar, but the perfect insects are quite different. It also appears to be more generally distributed, for I have taken it in many localities near Sydney where *H. picta* did not occur, and at Newcastle, about sixty miles to the north of Sydney;

and I have no doubt that it is to be found throughout New South Wales wherever *Cladium* grows.

The full-grown larva is elongate, cylindrical, and tapers slightly towards each extremity; general colour pale transparent yellowish green, inclining to rosy upon the two posterior segments; dorsal stripe dark green, pulsating; a paler yellowish green subdorsal stripe, bordered above and below by a darker shade of colour; head somewhat cordate, cinnamon-brown, with a central line down the face, and a dark V-shaped mark above the mouth. Feeds upon *Cladium mariscus*, &c. The chrysalis does not differ in any way from that of *Hesperilla picta.*

Note.—The *Hypolimnas*, whose life-history is given in this paper, appears to be a very different insect from the *H. bolina* of India, and I would therefore suggest that the Fabrician name *nerina* be adopted for it.

Explanation of Plate VI.

Fig. 1. Larva of *Ornithoptera urvilliana*, Guer.
2. „ *Papilio anactus*, Macl.
3. „ *P. indicatus*, Butl.; 3 (*a*), ditto, var.; 3 (*b*), pupa of ditto.
4. Pupa of *Pieris latilimbata*, Butl.
5. Larva of *Netrocoryne repanda*, Feld.
6. „ *Pieris teutonia*, Fabr.; 6 (*a*), ditto.
7. „ *Callidryas gorgophone*, Boisd.
8. „ *Epinephele abeona*, Don.
9. „ *Hesperilla picta*, Leach; 9 (*a*), pupa of ditto.
10. „ *Pyrameis itea*, Fabr.
11. „ *Junonia vellida*, Fabr.
12. Pupa of *Eurycus cressida*, Fabr.
13. Larva of *Doleschallia herrichii*, Butl.; 13 (*a*), pupa of ditto.
14. „ *Acræa andromacha*, Fabr.; 14 (*a*), pupa of ditto.

VII. *Descriptions of new or little-known species of phytophagous* Coleoptera *from Africa and Madagascar.* By Martin Jacoby, F.E.S.

[Read April 4th, 1888.]

Plate VII.

Sagra opaca, n. s. (Pl. VII., fig. 7).

Elongate, black, opaque; head minutely punctured; thorax longer than broad, impunctate; elytra finely punctate-striate, the apices impunctate, the striæ slightly approached in pairs.

♂. The intermediate femora dilated into a strong triangular tooth; the posterior ones extending far beyond the elytra, their upper edge deeply channelled at the posterior portion, bounded above by an acute ridge, their base furnished with an ovate tomentose fulvous patch; their lower edge armed with a stout tooth near the apex; posterior tibiæ slender, obsoletely bidentate near their apices. Length, 7—9 lines.

Head very finely punctured at the vertex; antennæ half the length of the body, black, the joints gradually increasing in length, finely punctured; thorax about one-half longer than broad, the anterior angles blunt, but slightly produced, the sides rather concave, the surface impunctate at the disc, the basal portion with a few very minute punctures; elytra not raised at the basal portion, impressed within the shoulder, the punctures slightly approached in pairs, entirely disappearing near the apices, the interstices flat and impunctate without rugosities.

Hab. Manboia, East Africa.

The present species is evidently closely allied to *S. bicolor* and *S. tristis*: from the former it differs in the triangularly dilated and toothed intermediate femora, in the more elongate thorax, and in the shape and structure of the posterior femora, which are proportionately longer and more slender at the base; the first abdominal segment, like that of *S. bicolor*, is longitudinally depressed, but devoid of any fulvous pubescence as in the last-named species; there is also

an entire absence of any metallic colour, which is generally present at the elytra in *S. bicolor*. *S. Kirbyi*, Baly, differs in its general coloration, being obscure olive-green; the elytra are much more distinctly and closely punctured, the punctuation more decidedly geminate, and the interstices are also punctured; the femora are much shorter and less slender, and their upper edge less distinctly channelled. The four specimens contained in my collection are all males; the female is unknown to me.

Lema cribraria, n. s.

Below piceous, above obscure metallic greenish; thorax transversely plicate-rugose; elytra very closely and deeply punctured, the punctures smaller and subconfluent towards the apices.

Var. Elytra fulvous, the sutural and lateral margins obscure æneous, under side fulvous. Length, 3½ lines.

Head with a few punctures at the vertex, the latter divided by a deep longitudinal groove; eyes very large and prominent, deeply notched; clypeus broadly triangular, black, with some transversely-placed punctures; antennæ stout, black, not extending much beyond the base of the elytra, the third and fourth joints nearly equal, the following dilated; thorax slightly longer than broad, moderately constricted at the middle, the entire surface transversely and irregularly rugose, without punctures, the space near the base with more distinct and contiguous strigæ; scutellum slightly emarginate at the apex; elytra cylindrical, of an obscure greenish-æneous colour, closely and deeply punctured, the punctuation only arranged in regular rows near the suture, the rest divided (more distinctly at the sides) by transversely-raised intervals, the punctuation becoming very irregular, finer, and nearly confluent near the apex, where they again assume the position of rows near the sides, the interstices being there raised and connected with those to be seen near the suture. Under side and legs piceous.

Hab. Cameroons, W. Africa; Delagoa Bay (var.), (*Mrs. Monteiro*), (my collection).

This species, although closely allied to *L. Dregei*, *L. australis*, and *L. azurea*, seems to differ from all in the punctuation of the elytra, which is much more closely placed, and consisting of about twelve rows of punctures, which towards the apex become very small and irregular, often confluent; the elytra have no trace

of a basal depression, and are convex and subcylindrical. In all the allied species the elytra have ten rows of deep and for the most part regularly-placed punctures. Their epipleuræ in the present species are often obscure piceous, as is also the extreme base of the thorax.

Lema apicicornis, n. s.

Black; the head, the basal and two apical joints of the antennæ, and the thorax, fulvous; elytra metallic-blue, deeply depressed below the base; abdomen fulvous. Length, $2\frac{1}{4}$ lines.

Head impunctate, without frontal elevations; eyes very large, but slightly notched; clypeus black at its lower portion; antennæ half the length of the body, black, the two basal and the two apical joints fulvous; thorax about as broad as long, rather deeply constricted at the middle, the anterior angles slightly tuberculiform, the basal sulcation deep and placed at some distance from the basal margin, the surface without punctures; scutellum fulvous; elytra with the basal portion strongly raised and bounded behind by an oblique depression extending from within the shoulders to the suture, the punctuation strong anteriorly, gradually diminishing towards the apices, the interstices nearly flat, the ninth stria not interrupted at the middle, the lateral margin with a deep longitudinal depression below the shoulders, very strongly punctured within this depression; breast and legs black; abdomen fulvous.

Hab. Old Calabar. A single specimen in my collection.

Allied to *L. rubricollis*, Klug, but differing in the colour of the head and that of the antennæ.

Lema laticollis, n. s. (Pl. VII., fig. 1).

Black; thorax fulvous, scarcely constricted; elytra deeply punctate-striate, pale fulvous, each elytron with six black spots (1, 2, 1, 1, 1); legs fulvous, spotted with black. Length, 2 lines.

Head sparingly clothed with very short golden hairs, the vertex black, spotted with fulvous at the sides and at the middle, the latter divided by a deep longitudinal groove, the frontal elevations absent; eyes deeply notched, with the usual grooves near their inner margins, lower part of the face fulvous; labrum black; antennæ short and very robust, the four lower joints very small, transverse, the following joints equal, broader than long, opaque, and pubescent; thorax nearly square-shaped, the sides but slightly

constricted at the middle, the basal sulcation scarcely indicated, the disc with a few minute punctures placed longitudinally at the middle; scutellum black; elytra with very deep and regularly-placed punctures, the interstices costate at the sides, each elytron with six black spots, of which one is placed at the shoulder, one at the sides below the base, another in a transverse line with the last near the suture, a fourth at the middle, the fifth below the latter near the suture, and the sixth near the apex; under side black, finely pubescent, the sides and margins of the abdominal segments fulvous; legs short and robust, fulvous; the knees, the apices of the tibiæ and tarsi, black.

Hab. Delagoa Bay. A single specimen was obtained by Mrs. Monteiro (my collection).

Colasposoma foveipenne, n. s.

Metallic cupreous or blue; the antennæ (the basal joints excepted) and the tarsi black; head finely rugose-punctate; thorax closely and finely punctured; elytra more strongly but as closely punctured, with a deep greenish fovea below the base. Length, 2—2½ lines.

Head flat, extremely closely and finely semirugose-punctate, the clypeus margined with metallic-green, its lower edge deeply concave-emarginate; labrum piceous; antennæ black, the first joint metallic-green above, the following two joints fulvous; thorax nearly three times broader than long, the sides rather evenly rounded, the posterior margin strongly produced and rounded at the middle, the surface closely and finely punctured throughout, the punctuation more crowded and of more elongate shape towards the sides, the disc reddish or cupreous, the margins narrowly metallic-green; scutellum with a few fine punctures; elytra more strongly punctured than the thorax, the punctuation arranged in very close irregular rows, the shoulders prominent; below the base a deep oblique fovea is placed, extending more feebly towards the shoulders and deeply punctured within; the sutural and lateral margins are also narrowly metallic-green; the under side and legs are coloured like the upper surface; the femora have a minute tooth.

Hab. Madagascar (my collection).

The close and fine punctuation of the head and thorax, the prominent median lobe of the posterior margin of the latter, and the deep elytral fovea in connection with the general coloration, separate the present

insect from its other African allies. The variety does not differ except in the entirely dark blue colour.

Colasposoma humerale, n. s.

Metallic green or blue; antennæ and legs testaceous, the 7th and 8th joints of the former fuscous; thorax very closely and finely punctured; elytra closely and more strongly punctured, the shoulders prominent and smooth, bounded by a deep transverse depression. Length, 2½ lines.

Head closely and finely punctured, strigose at the vertex, the lower part separated from the front by a shallow sinuate groove; the clypeus punctured and strigose at the base; labrum piceous; palpi fulvous; antennæ long and slender, testaceous, the seventh and eighth and the apical joint fuscous, the third very long and slender; thorax more than twice as broad as long, the sides nearly straight, the entire surface covered with very fine, closely approached, and partly oblong punctures, not stronger at the sides than at the disc; elytra closely and much more strongly punctured, the entire humeral callus prominent and swollen, bounded within and below by a deep depression, which in the green specimens is of a metallic-blue colour; the sutural and lateral margins are also narrowly metallic-blue; legs testaceous; abdomen piceous.

Hab. Madagascar (my collection).

Principally distinguished by the colour of the antennæ and legs, and the prominent shoulders in connection with the fine and evenly punctured thorax.

Chrysomela (Polysticta) madagascariensis, n. s.
(Pl. VII., figs. 6, 6*a*).

Broadly rounded, very convex, black; thorax very transverse, piceous; elytra obscure testaceous, closely punctate-striate. Length, 4 lines.

Head flattened, scarcely visibly punctate, nearly black; antennæ scarcely extending beyond the base of the thorax, black, the five last joints gradually transversely widened; thorax at least three times broader than long, the sides narrowed towards the apex, slightly rounded, the anterior margin deeply concave, the sides with some rather strong punctures, the middle of the disc impunctate, brownish piceous; scutellum triangular, smooth, piceous; elytra very convex towards the middle, deflexed from there to the apex, where they are gradually narrowed, obscure fulvous or testaceous, impressed with closely approached rows of distinct punctures, which somewhat approach in pairs towards the

sides, a narrow space in front of the lateral margin impunctate; under side and legs black; abdomen obscure fulvous; prosternum oblong, slightly narrowed at the middle, longitudinally depressed; claws simple.

Hab. Madagascar (my collection).

This species, at present the only representative of the genus known from Madagascar, is at once distinguished from any other of its allies by the peculiar transversely-shaped and short thorax, giving it the appearance of a *Coccinella*, although peculiarly unadorned in regard to its coloration.

Oedionychis madagascariensis, n. s. (Pl. VII., fig. 3).

Testaceous; the three apical joints of the antennæ, the scutellum, breast, and the femora, black; thorax impunctate; elytra minutely punctured, depressed below the base. Length, 4 lines.

Head impunctate, deeply transversely impressed between the eyes; the clypeus raised into an acute triangular point between the antennæ; palpi testaceous, the apical joint piceous; antennæ slender, nearly half the length of the body, testaceous, the apical three joints black; third joint twice as long as the second; thorax about twice and a half broader than long, narrowed towards the front, the sides nearly straight, rather broadly flattened, the anterior angles produced, the posterior margin broadly rounded at the middle, the disc entirely impunctate, slightly convex near the posterior angles; scutellum black; elytra scarcely widened towards the apex, transversely depressed below the base, and longitudinally in front of the lateral margin, the surface very minutely and rather closely punctured; femora and the upper side of the tarsi black; claw-joint more or less fulvous.

Hab. Matanga, Madagascar.

The single specimen contained in my collection differs entirely from the other three or four species known from Madagascar on account of the differently structured head and thorax and the coloration, principally in regard to the antennæ, scutellum, breast, and legs.

Blepharida nigromaculata, n. s. (Pl. VII., fig. 5).

Dark fulvous; thorax flavous at the sides, impressed with short anterior and basal grooves; elytra flavous, deeply punctate-striate, with eight or nine spots on the disc, and some others at the lateral margins, black. Length, 3 lines.

Head flat, with a few fine punctures, and two short longitudinal grooves between the eyes; antennæ entirely fulvous, only extending to the base of the elytra; thorax nearly three times broader than long, the sides straight at the base, slightly rounded before the middle, the posterior margin very slightly oblique at the sides and but little produced at the middle; the surface impunctate, obscure pale fulvous, the sides more or less bright flavous; at the sides of the anterior margin a short but deep and slightly curved groove runs downwards towards the middle; another very short groove in a line with the anterior one is placed at the posterior margin; elytra with the punctures slightly placed in pairs and of dark fulvous colour, the interstices flavous and spotted with black; of these spots one is placed on the shoulders, two transversely on the basal margin, one near the suture at the junction of the first and second row of punctures, another below the middle near the suture between the first and third row of punctures, two others lower downwards; the third and fourth rows of punctures and the fifth to the eighth rows are also connected by black spots below the base and below the middle, and five spots of variable shape and sizes are placed along the lateral margin, corresponding partly with similar spots at the elytral epipleuræ; under side dark fulvous, finely pubescent; the posterior femora very strongly dilated and incrassate; prosternum straight at its base.

Hab. Delagoa Bay (*Mrs. Monteiro*), (my collection).

The elytral spots vary greatly in different individuals, but are always placed in the same positions as given above; they are more or less connected with each other, and appear generally as an interrupted transverse short band below the middle, when looked at with the naked eye, the other spots being still more separated.

Blepharida laterimaculata, n. s. (Pl. VII., fig. 9).

Testaceous; antennæ and legs fulvous; thorax with two deep anterior depressions, obsoletely spotted with fulvous; elytra deeply punctate-striate, the interstices costate, the lateral margin spotted with fulvous. Length, 3 lines.

Head rather closely punctured between the eyes, with two short perpendicular grooves in front of the antennæ; the latter short, fulvous; thorax three times broader than long, the sides rounded or subangulate in front, narrowly margined, the anterior angles subtuberculiform, the posterior margin obliquely shaped at each side, its median lobe broadly rounded, the surface rather flattened

and impunctate, flavous or testaceous, obsoletely blotted with fulvous; at each side a deep but short fovea is placed; elytra longitudinally costate throughout, the interstices deeply punctate-striate; a row of spots is placed at the lateral margin, commencing at the shoulder; prosternum, with its base, truncate.

Hab. South Africa. Three specimens are contained in my collection.

Blepharida ornaticollis, n. s. (Pl. VII., fig. 8).

Fulvous; above flavous; head closely punctured; thorax with one anterior and two posterior grooves, fulvous, the sides and a central stripe flavous; elytra closely punctate-striate, a spot at each shoulder, two at the sides, one near the apex, two or three sutural spots, and the striæ, dark fulvous. Length, 8 lines.

Head convex at the vertex, closely and finely rugose-punctate; antennæ fulvous or flavous, extending slightly beyond the thorax, the third joint more slender and longer than the rest; thorax three times broader than long, strongly rounded at the sides near the middle, the anterior angles produced, with a deep transverse groove near the anterior and two equally deep and sinuate grooves near the posterior margin; at the sides are similar grooves running parallel with the lateral margin; all these grooves are of a dark fulvous colour, as well as two broad irregularly-shaped bands placed at the sides; these bands are deeply but narrowly indented at their inner and outer margins, and impressed with deep but irregularly-placed punctures; a small spot near the anterior angles and a short stripe at the middle of the disc completes the design of the thorax; scutellum piceous; elytra flavous, deeply punctate-striate, the punctures dark fulvous, the sutural stripe extending to near the middle; a piceous or fulvous spot is placed at the shoulder; one at the middle of the lateral margin, another in the same line at the middle of the disc, and a fourth near the apex; besides these spots the suture has four or five spots placed at unequal distances, some others are situated below the middle at the lateral margin and the epipleuræ; below dark fulvous, finely pubescent.

Hab. Africa. Three specimens are contained in my collection.

The spotted thorax and the position of the elytral spots separates *B. ornaticollis* from other African species previously described.

Blepharida intermedia, n. s. (Pl. VII., fig. 4).

Dark fulvous; the seven apical joints of the antennæ black; thorax flavous, with two broad bands and a central stripe fulvous; elytra deeply punctate-striate, flavous, the suture with four, the disc with about eight or nine dark fulvous spots or bands. Length, 4 lines.

Head extremely closely and finely rugose-punctate; fulvous; palpi flavous, long and slender; antennæ extending beyond the base of the elytra, the four first joints fulvous, the rest black; thorax about three times broader than long, the sides angulate before the middle, concave towards the base, the anterior and posterior angles obliquely cut, the posterior margin sinuate at each side, and accompanied, like the anterior margin, by a narrow but deep transverse groove; an oblique row of deep punctures is placed near the anterior angles at each side, sending off a short branch upwards and a longer one towards the middle of the disc; the surface is further impressed with smaller punctures within and larger ones near the sides, the latter have a broad fulvous band of irregular shape, not extending to the lateral margin; a short longitudinal stripe is also placed between these two bands at the base, some smaller piceous spots are seen at the anterior margin; scutellum flavous, margined with fulvous; elytra flavous, with ten rows of closely approached piceous punctures, the first short; at the base four piceous spots are placed in a transverse line, of which the one at the shoulder is in the shape of a narrow longitudinal stripe; a transverse broader band, strongly narrowed at the sides, occupies the middle of the disc; below this band two more spots occupy the lateral and some others the apical margin, another larger subquadrate spot is further placed near the apex of each elytron; the suture is also furnished with four transversely-shaped short spots or bands, of which one surrounds the scutellum, one is placed before, another below the middle and the fourth near the apex; these sutural spots are here and there connected with those on the disc by short transverse lines, forming a kind of network near the apex; under side covered with fine and short silvery pubescence; the anterior tarsi in the male insect dilated; prosternum rather convex, subtruncate at its apex.

Hab. Mombas, Zanzibar (my collection).

Cladocera nigripennis, n. s. (Pl. VII., fig. 2).

Broadly oblong-ovate, robust, flavous; the base of the head, antennæ, the apices of the femora, and the tibiæ and tarsi, black:

thorax finely punctured; elytra black, closely semirugose-punctate. Length, 6 lines.

♂. Head rather remotely but distinctly punctured at the vertex, the latter black; the lower portion of the face flavous; the space between the eyes impressed with two short foveæ and a few deep punctures; antennæ simple, half the length of the body, black, the basal joint fulvous below, the fourth joint longer than the others, the intermediate joints slightly widened, robust; thorax three times broader than long, the sides but slightly rounded towards the apex, the anterior angles produced towards the head, the posterior margin sinuate at each side, the surface with several irregular depressions, unevenly punctured throughout, flavous; scutellum flavous; elytra broad, robust, closely punctured, the sides finely rugose, the interstices also covered with minute punctures; below flavous, the sides of the breast, the upper margin, and the apices of the femora and the tibiæ and tarsi, black; anterior tarsi of the male dilated.

Hab. Nguru, Central Africa. A single male specimen is contained in my collection.

Cladocera zanzibarica, n. s.

Black; the lower part of the face and the thorax flavous; antennæ with triangularly dilated joints; elytra black, finely rugose-punctate, the lateral margin narrowly fulvous. Length, 5 lines.

♀. Head impressed with oblong punctures at the sides of the vertex, the latter black, the lower portion flavous, with some deep punctures between the eyes; antennæ short, not extending much beyond the base of the elytra, black, the fourth and following joints triangularly dilated; the thorax of the same shape as *C. nigripennis*, and punctured in the same way; scutellum flavous; elytra finely rugosely punctured throughout, their extreme lateral margin and their epipleuræ fulvous; under side and legs black; the margins of the abdominal segments fulvous; the pygidium flavous above.

Hab. Zanzibar.

This species, of which a single female specimen is contained in my collection, is very closely allied to the preceding one, but represents, I believe, a distinct form, on account of the shape of the antennæ, which probably have their joints serrate in the male insect; other differences are to be found in the entirely black under side and legs, and in the fulvous elytral margins.

AETHONEA, *Baly.*

The anterior coxal cavities in this genus are closed; this and the mucronate posterior tibiæ would place *Aethonea* in the twentieth group of Chapuis' arrangement, the *Sermylinæ.* The serrate antennæ seem to be peculiar to the male sex only, at least in the species here described. *Ootheca serricornis,* Thoms., belongs doubtless to this genus.

Aethonea variabilis, n. s. (Pl. VII., figs. 14, 15).

Fulvous; the antennæ (the three basal joints excepted), the femora, and tibiæ partly, black; thorax finely, elytra closely, punctured, the latter with four small black spots placed transversely.

Var. *a.* The sides of the thorax and the lateral margin of the elytra below the middle black.

Var. *b.* Elytra black, the shoulders and the suture fulvous.

Var. *c.* Elytra entirely black.

Var. *d.* Elytra without any black markings (*A. Murrayi?,* Baly). Length, 4—4½ lines.

Head with a few fine punctures, longitudinally grooved at the middle; antennæ half the length of the body, the second and third joints very small, equal, the fourth longer than the three preceding joints together, the third and the five following joints serrate in the male, simple in the female; thorax at least three times broader than long, the sides rounded, the posterior margin somewhat obliquely shaped at the angles, nearly straight at the middle, the surface with some fine rather scattered punctures; elytra convex, scarcely widened posteriorly, longitudinally depressed within the shoulders, more strongly punctured than the thorax, the punctuation close and here and there arranged in rows, the interstices slightly rugose, and forming occasionally narrow smooth longitudinal ridges; under side and legs variable in colour.

Hab. Old Calabar, Maemba, West Africa (my collection).

In a single female specimen, which agrees in most respects with the males, the antennæ are simple, the third joint is slightly longer than the second, and the fourth as long as the three preceding joints; the apical joints are distinctly shorter. In this specimen the thorax has a black band at each side, and a similar band is placed from the middle of the lateral margin to

the apex of each elytron; the two black spots of the latter are present, as in the other specimens; the sides of the breast, the abdomen, and the tibiæ are more or less stained with piceous. In the var. *c*, which does not materially differ from the normal forms, the entire elytra are black and rather more finely punctured. Mr. Baly, in his diagnosis of the genus, gives the antennæ as nearly equal to the body in length; this is not the case with any of the male specimens before me, in which the antennæ do not exceed half the length.

Mesodonta submetallica, n. s. (Pl. VII., fig. 10).

Metallic green or blue; antennæ black, the apical joints dilated; thorax with several depressions, rugose-punctate; elytra fulvous, with a metallic gloss, finely and closely rugose. Length, 4—4½ lines.

Head metallic blue, strongly rugose; labrum testaceous; palpi fulvous; antennæ nearly half the length of the body, black, the third joint the longest, the fifth to the terminal joints gradually shortened and dilated; thorax transverse, the sides deflexed, the lateral margins nearly straight, the posterior angles oblique, the surface with a depression near the anterior margin and another one of oblique shape at each side, bright metallic-blue or green, closely and strongly punctured and rugose; scutellum broad, metallic violaceous, punctured; elytra dark fulvous, with a slight purplish gloss, extremely finely and closely punctured and rugose, their epipleuræ indistinct below the middle; legs robust, metallic bluish; tibiæ channelled; the first joint of the posterior tarsi rather shorter than the two following joints together; claws bifid; the anterior coxal cavities open.

Hab. N'gami, Zambesi, Africa (my collection).

The dilated terminal joints of the antennæ, the impressed thorax, channelled tibiæ, and bifid claws seem to me to place the present insect in *Mesodonta*; the male does not, however, possess the spine at the intermediate tibiæ, as in *M. marginata*, Baly.

Otacilus, n. g. (*Galerucinæ*).

Body elongate; antennæ filiform, the third joint one-half longer than the second; thorax transverse, the posterior margin rounded, the sides narrowed towards the apex; surface without depressions; elytra irregularly punctured, their epipleuræ narrow, continued

below the middle; legs elongate; all the tibiæ with a small spine; the first joint of the posterior tarsi as long as the two following joints together; claws bifid; anterior coxal cavities closed.

Amongst the genera with closed coxal cavities *Otacilus* would perhaps best be placed amongst the *Sermylinæ*, on account of the mucronate tibiæ; from *Merista*, which has also bifid claws, the genus differs in the longer third joint of the antennæ, in the more transversely and different shape of the thorax, and in the parallel, not posteriorly dilated elytra. I would have considered the present genus identical with *Malaconida*, Fairm., had not the author described the tibiæ as unarmed, and the second and third joint of the antennæ as equal.

Otacilus fulvus, n. s.

Fulvous; the antennæ, the apices of the femora, and the tibiæ and tarsi, black; thorax and elytra closely punctured. Length, 4—4½ lines.

Head with a few fine punctures between the eyes and deeply transversely grooved; the frontal tubercles transverse, strongly raised; the clypeus narrow, triangular; palpi piceous; antennæ about half the length of the body, black, the third joint one-half longer than the second, the following joints elongate (the terminal ones broken off). Thorax transverse, the sides rounded before the middle, the anterior angles tuberculiform, the anterior and posterior margins parallel, the latter rounded, the surface impressed with small and smaller punctures, closely arranged, a narrow space at the middle more or less smooth; elytra elongate, the sides rather strongly deflexed, the surface very closely, finely, and evenly punctured; under side and legs fulvous, the apices of the femora and the tibiæ and tarsi black.

Hab. Madagascar.

The three specimens which are contained in my collection are probably all females.

Spilocephalus, n. g. (*Galerucinæ*).

Body elongate; antennæ robust, the second joint short, the third slightly shorter than the fourth joint; thorax transverse, with two transverse depressions; elytra closely punctured and transversely rugose, their epipleuræ continued below the middle; legs unarmed; the first joint of the posterior tarsi as long as the three following joints together; claws appendiculate; anterior coxal cavities closed.

Type. *Spilocephalus viridipennis.*

This genus will enter the group of *Platyxanthinæ*, on account of the characters pointed out above; it seems nearly allied to *Stenoplatys* and *Metrioidea*, but differs from the former in the short and robust antennæ, the want of elytral depressions, and the general narrower and elongate shape; from *Metrioidea* the genus differs equally in the shorter antennæ and metatarsus of the posterior legs.

Spilocephalus viridipennis, n. s. (Pl. VII., fig. 12).

Fulvous; the base of the head metallic-green; thorax biimpressed, punctured posteriorly; scutellum black; elytra bright metallic-green, closely rugose and punctured. Length, 3½ lines.

Head slightly longer than broad, finely punctured at the vertex, the latter metallic-green, the lower portion fulvous; the space between the eyes deeply transversely grooved; the clypeus triangular, with a distinct central ridge, its lower edge concave; antennæ robust, less than half the length of the body, the lower joints fulvous, the others more or less fuscous; thorax more than twice as broad as long, the sides rounded or nearly subangulate at the middle, distinctly narrowed towards the base, the posterior margin slightly rounded and sinuate, the disc deeply transversely depressed, the depression interrupted medially, distinctly punctured, the anterior portion scarcely visibly punctate; scutellum triangular, black, smooth; elytra metallic-green, the punctuation arranged in very closely approached rows, the interspaces everywhere transversely rugose; legs and under side fulvous.

Hab. South Africa (my collection).

HALLIRHOTIUS, n. g.

Body elongate; antennæ filiform, slender, the third and following joints elongate; palpi very long and slender; thorax transversely subquadrate; elytra irregularly punctured, their epipleuræ continued below the middle; tibiæ mucronate; the first joint of the posterior tarsi as long as the two following joints together; claws bifid; anterior coxal cavities open.

Type. *Hallirhotius africanus.*

In general appearance *Hallirhotius* agrees with *Malacosoma*, from which the bifid claws at once separate it; the palpi are unusually long, and the thorax is strongly transverse but subquadrate.

Hallirhotius africanus, n. s.

Testaceous or fulvous; the terminal joints of the antennæ and the tarsi more or less fuscous or black; thorax very finely punctured; elytra metallic-bluish green, finely punctured, their apices fulvous. Length, 3½ lines.

Head broad at the base, the vertex convex, fulvous, very finely punctured, with an obsolete longitudinal central groove; eyes moderate; apex of jaws black; palpi long and slender, fulvous, the terminal joint long and acutely pointed; antennæ about two-thirds the length of the body, black, the three basal joints fulvous; the third and following joints long and slender in the male, shorter in the female; thorax nearly three times broader than long, all the margins nearly straight, the angles obtusely thickened, the surface somewhat convex, without depressions, and finely punctured; scutellum fulvous; elytra nearly parallel, the base rather elevated, depressed below and within the shoulders, the surface very closely and distinctly punctured, metallic dark blue, the apex with a triangular-shaped flavous spot; under side and legs fulvous or flavous.

Hab. Zanzibar and Central Africa (my collection).

SCHEMATIZELLA, n. g. (*Galerucinæ*).

Body oblong; antennæ dilated at the terminal joints; thorax transverse, the sides subangulate, the angles acute, produced; elytra rugosely punctured, their epipleuræ extremely narrow; tibiæ simple, unarmed; the first joint of the posterior tarsi as long as the three following joints together; claws bifid; the anterior coxal cavities open.

The widened terminal joints of the antennæ, the shape of the thorax, scarcely visible elytral epipleuræ, and the bifid claws form a number of characters which allow of a comparatively easy recognition of the present genus amongst the numerous *Galerucidæ*.

Schematizella viridis, n. s. (Pl. VII., fig. 11).

Flavous; the six or seven terminal joints of the antennæ black; the base of the head and the thorax green, rugosely punctured; elytra opaque, green, finely rugose, the lateral margin narrowly flavous. Length, 3—3¼ lines.

Head strongly rugose at the vertex, the latter metallic-green; lower part of the face flavous; the clypeus forming a narrow

transversely-raised ridge; palpi flavous, the terminal joint conical, longer than the preceding one; antennæ less than half the length of the body, the first joint dilated, rather short, the second ovate, short, the third more than twice the length of the second, the rest gradually shortened and widened, the four lower joints flavous, the others black; thorax more than twice as broad as long, the sides obtusely angulate before the middle, the angles tuberculiform, flavous, the posterior margin straight, the entire surface strongly rugose, bright green, subopaque; scutellum flavous, slightly pubescent; elytra without basal depression, parallel, much more finely and evenly rugose throughout; under side and legs flavous.

Hab. Cameroons, Africa (my collection).

Apophylia smaragdipennis, n. s. (Pl. VII., fig. 18).

Obscure purplish or greenish black; antennæ, lower part of the face, and legs, flavous; above metallic-green, finely punctured and transversely wrinkled. Length, 2—3 lines.

Head broad at the base, minutely granulate and punctured; the frontal tubercles ovate, strongly raised. lower part of the face and the labrum flavous; antennæ more than half the length of the body, fulvous, the first joint strongly thickened, club-shaped, the third one-half longer, the terminal joints more slender and elongate; thorax transverse, the sides rounded and narrowed towards the base, the anterior and posterior margins nearly straight, the sides finely margined and rather deflexed, the extreme lateral margin and the under side flavous, the disc metallic-green, finely punctured and transversely strigose, with a short transverse depression near the anterior margin; scutellum rather broad, trigonate; elytra narrowly parallel, finely transversely wrinkled throughout, their epipleuræ broad at the base, gradually narrowed towards the middle; under side covered with fine silky pubescence, metallic-greenish or purplish; legs flavous, the four anterior tibiæ mucronate, the posterior ones unarmed; claws appendiculate; anterior coxal cavities open.

Hab. South Africa, Cape Town (my collection).

This is probably the *A. smaragdina*, Dej., of which Chapuis, in his diagnosis of the genus, speaks, and which served him for the type, but I can find no published description of the species. The generic characters, as pointed out by Chapuis, are all present in the insect before me, but some slight differences are noticeable. Chapuis gives the fourth joint of the antennæ as the

longest, and the following joints as gradually shorter: in my specimens the third and following joints are very nearly equal. The thorax in all has a short transverse depression near the anterior margin; Chapuis, however, gives the thorax as convex and without depression; it may be therefore that he had another species before him. *A. smaragdipennis* differs somewhat in shape, some specimens being shorter and more dilated posteriorly than the others. The sides of the thorax in most specimens are narrowly margined with flavous, as well as its under side; in others this colour is absent, but these specimens do not seem to differ in other respects. The species does not seem to be an uncommon one in South Africa.

Notes.

Hovalia, Fairmaire (1881) = *Alphidia*, Clark, Ann. and Mag. Nat. Hist. (1865).

Tropidophora tripartita, Thoms., Arch. Ent., ii., 1858, seems identical with *Physoma Dohrni*, Chap. The species is placed in Gemminger's Catalogue amongst the *Galerucinæ*, but Thomson mentions distinctly the "enormously" dilated posterior femora.

Ootheca cyaneovittata, Fairm. ('Naturaliste,' 1880). This insect cannot find its place in *Ootheca*, if *O. mutabilis* is looked upon as the type; it differs totally in general shape, in the structure of the thorax, want of elytral epipleuræ beyond the middle, and the much longer first joint of the posterior tarsi.

Explanation of Plate VII.

Fig. 1. *Lema laticollis.*
2. *Cladocera nigripennis.*
3. *Oedionychis madagascariensis.*
4. *Blepharida intermedia.*
5. „ *nigromaculata.*
6. *Chrysomela madagascariensis*; 6 *a*, side-view.
7. *Sagra opaca.*
8. *Blepharida ornaticollis.*
9. „ *laterimaculata.*
10. *Mesodonta submetallica.*
11. *Schematizella viridis.*
12. *Spilocephalus viridipennis.*
13. *Apophylia smaragdipennis.*
14, 15. *Aethonea variabilis.*

VIII. *Additional observations on the Tea-bugs* (Helopeltis) *of Java.* By Charles O. Waterhouse, F.E.S.

[Read April 4th, 1888.]

Some eighteen months ago I communicated to this Society some notes on the tea-pests (Trans. Ent. Soc. Lond., 1886, p. 457). At that time I had not seen specimens from the tea-plants in Java, and only surmised that these would prove to be distinct from those infesting the cinchona. By the kindness of Mr. H. B. Brady I am now able to exhibit a series of specimens from the tea-plantations in Java, sent by Mr. H. van Romunde for examination. They belong to a distinct species, as I thought would be the case, and I propose to call it

Helopeltis Romundei.

♂. Black and shining; legs pale dirty yellowish, mottled with light brown. Scutellar spine pale dirty brown, pale yellow at the base, formed as in *H. Bradyi*, very little curved, slender. Abdomen with a narrow line of yellow at the sides of the basal segments. Legs much paler than in *H. Bradyi.*

♀. Pronotum red, with a dusky line near the front margin. Scutellar spine longer than in the male, and distinctly curved; a character in which it differs from both *H. Bradyi* and *Antonii.* Abdomen with more yellow at the sides. The rest as in the male.

The scutellar spine, although a little longer than in *H. Bradyi* and *Antonii*, is much shorter than in *H. theivora*, and is less curved than in this last species.

This subject is of considerable interest, as the species infesting the cinchona in Java was supposed to have been introduced from Ceylon in tea. I have now, however, shown that the species on the tea and on the cinchona in Java are distinct, and both are distinct from *H. Antonii* from Ceylon. There is, however, one point to be corrected. Mr. Trimen, from whom I received the specimens referred to in my first paper as from Ceylon, informs me that he took them from cacao, and not from tea.

IX. *On the* Pyralidina *of the Hawaiian Islands.*

By E. Meyrick, B.A., F.E.S.

[Read May 2nd, 1888.]

I am indebted to the Rev. T. Blackburn for the material which forms the subject of this paper. He has been good enough to make over to me the bulk of the collection of Heterocera formed by him during six years' residence in the Hawaiian Islands, and the exceptional position of these islands renders the accurate knowledge of their fauna a subject of great interest. Many of the species have, indeed, been described by Mr. A. G. Butler, but his work has not been of a character to throw much light upon their systematic classification and affinities. I am bound to add that, after comparison of the named types in the British Museum with the descriptions drawn from them, I find the latter frequently so inaccurate that I am unable to reconcile the differences. I have therefore found it necessary to re-describe all species not sufficiently described elsewhere. Mr. Blackburn furnished me with no notes on any of the species, and I have therefore added nothing on this head, except in the case of those few insects which I took myself during a day spent at Honolulu some years ago. The following remarks are a summary of the results obtained for this group on the questions of development and geographical distribution.

Of Hawaiian *Pyralidina*, 56 species are at present known. Of these the genera *Asopia*, *Zinckenia*, *Eromene*, *Ephestia*, and *Achroea*, including 7 species in all, have undoubtedly been introduced through the direct agency of man in recent times, and form no part of the native fauna. The single species of *Paraponyx*, though apparently unlikely of introduction, is extremely widely distributed, and, as hereafter explained, probably entered in the same way. *Platyptilia cosmodactyla* is probably also imported. The remaining 47 are, so far as is

known, wholly endemic. Of these, 26 belong to the *Botydidæ*, 12 to the *Scopariadæ*, 4 to the *Pterophoridæ*, 3 to the *Crambidæ*, and 2 to the *Phycitidæ*. The 26 species of *Botydidæ* are referable to 8 genera, falling in three very distinct groups. The first is represented only by the single species of *Margarodes*; this, although distinct, is closely allied to other species occurring in the islands of the South Pacific, Australia, the Malay Archipelago, and Ceylon, in each case confined within a limited range, and there can be little doubt that these are the little-modified descendants of one form, which at a date comparatively not very remote wandered, probably by means of its own powers of flight, which are considerable, over the whole of this area. The second consists of the genus *Omiodes*, containing seven species, an endemically developed group; the genus is known also from the South Pacific Islands, Malay Archipelago, and South America, but only to the extent of about eight species. The third group includes the oldest portion of the fauna, consisting mainly of *Scopula* (eight species), and three endemic genera allied to and probably derivable from *Scopula*; one species of *Eurycreon* and two of *Mecyna*. Although the three last-named genera are more or less represented in almost all regions, probability seems to be in favour of the origin of this part of the fauna from North America. Only one true *Scopula* occurs in Australia, and none in New Zealand or the South Pacific Islands. New Zealand, in fact, only possesses eight probably indigenous species of *Botydidæ* in all, but these belong to the same group; they are, however, apparently of South American origin.

The 12 *Scopariadæ* compare but poorly with the 60 species of that family occurring in New Zealand, but I have little doubt that Mr. Blackburn overlooked not a few of these obscure species, the material obtained being very scanty. They would probably be generally confined to the high mountains. It is remarkable that 10 out of the 12 are referable to *Xeroscopa*, hitherto principally known from New Zealand, but the species are more nearly allied to one another than to any from New Zealand.

The *Pterophoridæ* belong to the cosmopolitan genera *Platyptilia* and *Trichoptilus*, but probably incline to

North America in their affinities. *Aciptilia* appears absent, though represented by four species in New Zealand, and in the South Pacific by a widely-distributed species which occurs in many islands, as well as in Australia; but it is barely represented in North America.

The three species of *Crambidæ* are all referable to *Hednota*, and this is a very interesting identification. They are all of the lowest and most ancestral type of the genus, approximating to *Diptychophora.* Hitherto *Hednota* has been practically confined to Australia, where it is considerably developed; there is, indeed, a distinct species in New Zealand, but it is certainly to be traced to Australian origin. *Diptychophora* is confined to the Southern Hemisphere, and is largely characteristic of New Zealand, occurring also in South America and Australia. Probably the small and obscure Hawaiian species of *Hednota* are forms only preserved by isolation from extinction; in Australia they are superseded by large and handsomely-marked species of the same genus, evidently in a flourishing state; but everywhere else the genus appears to have been completely replaced by *Crambus*, which is not indigenous in Australia. I am disposed to be surprised that *Crambus* is not found in the Hawaiian Islands; it might have been expected to find its way from North America.

The two species of *Phycitidæ* are stray wanderers. One is an *Homœosoma*, a genus of few species, but represented by one or two distinct species almost everywhere. The larvæ probably feed in the seed-heads of *Compositæ*, and it is likely that the ova may be transmitted with the seeds of these. The other I have described as a new genus; it is nearly allied to the Australian *Crocydopora*, which also occurs (possibly introduced) in New Zealand.

On the whole, it will be seen that the *Pyralidina* of the Hawaiian Islands, although specifically highly peculiar, hardly present that amount of generic specialisation which might have been expected. I should be disposed to infer that this portion of their fauna consisted of two elements, *viz.* (1), a larger portion, composed of species whose ancestors were derived from North America, at a date sufficiently remote to allow of a great deal of specific development, and even a certain

amount of generic also; and (2), a smaller portion, the descendants of various stray immigrants from other regions round, mostly of later date, yet sometimes admitting of much specific modification. Immigration of this kind appears, from the great remoteness of these islands, to have been exceedingly scanty.

PYRALIDIDÆ.

1. Asopia, *Tr.*

1. *Asopia gerontialis*, Walk.

Pyralis achatina, Butl., Ent. Mo. Mag., xiv., 49.

I have given the full synonymy in earlier papers. This species occurs also in North-east Australia, Celebes, Java, Ceylon, and West Africa, and probably throughout the tropical regions of the Old World; it appears to take the place of the closely-allied *A. farinalis*, which is widely spread through the temperate regions of both hemispheres, but has not been recorded within the tropics. Both species have been undoubtedly carried throughout their range by human agency, and their original home is now uncertain.

HYDROCAMPIDÆ.

2. Paraponyx, *Hb.*

2. *Paraponyx linealis*, Gn.

Paraponyx linealis, Gn., 271; *Oligostigma chrysippusalis*, Walk., 432; *O. obitalis*, ib., 432; *O. curta*, Butl., Ent. Mo. Mag., xv., 270.

Also from Australia (according to Walker), Celebes, Sumatra, Java, China, India, Ceylon, and South Africa. Butler's type of *Oligostigma curta* differs from ordinary specimens only in having the ante-median dark line of hind wings somewhat protuberant in middle, so as to touch the dark margin of the following yellow band, and is certainly not specifically distinct. The larva is doubtless aquatic, like the rest of the genus, and it seems hardly probable that the species can have been transported to any extent by man; but in the absence of precise information as to its habits, it is useless to conjecture the cause of its immense geographical range. There must be some exceptional circumstance; with the exception of *P. nitens* (common to Australia and New

Zealand, but not hitherto recorded elsewhere), no other species of *Paraponyx* crosses any wide sea.

BOTYDIDÆ.

1.	Antennæ in ♂ with basal notch and projection ..	5. Zinckenia.
	„ „ without „ „ „ ..	2.
2.	Patagia of ♂ elongate, penicillate	4. Omiodes.
	„ „ moderate	3.
3.	Posterior tibiæ in ♂ with outer middle-spur obsolete.	6. Scopula.
	Posterior tibiæ in ♂ with outer middle-spur developed	4.
4.	Forehead with projection	11. Eurycreon.
	„ without „	5.
5.	Fore wings with vein 10 anastomosing shortly with 9	7. Protocolletis.
	Fore wings with vein 10 separate	6.
6.	Hind wings with veins 4 and 5 stalked	7.
	„ „ „ separate	8.
7.	Hind wings in ♂ with inner-marginal hairy lobe	10. Mestolobes.
	„ „ without „ „ „	9. Orthomecyna.
8.	Antennæ two-thirds of fore wings	8. Mecyna.
	„ more than three-fourths of fore wings	3. Margarodes.

3. Margarodes, *Gn.*

3. *Margarodes exaula*, n. s.

Margaronia glauculalis, Butl., Ann. Mag. Nat. Hist., 1881, 327 (nec Gn.).

Size of *M. oceanitis*. Pale sea-green; costa of fore wings white, costal edge from base to two-thirds slenderly orange; a black discal dot; no marginal dots; cilia apparently green-whitish (almost wholly worn off). Thorax whitish-greenish, shoulders narrowly orange. Head wholly greenish-whitish, except an orange mark on collar behind eyes. Palpi white, terminal third of labial palpi deep orange.

This diagnosis is taken from the specimen sent to the British Museum. The species differs considerably from *M. glauculalis*, and is nearer *M. oceanitis* and *M. tritonias*.

4. Omiodes, *Gn.*

1.	Fore wings with veins marked by pale lines ..	2.
	„ „ not marked by pale lines ..	3.
2.	Second line of fore wings with angulated projection outwards	4. *Blackburni.*

Second line of fore wings without angulated projection outwards	5. *accepta.*
3. Fore wings yellowish-ochreous	7. *demaratalis.*
„ fuscous	4.
4. Second line of fore wings nearly straight ..	6. *continuatalis.*
„ „ „ strongly bent or curved	5.
5. Hind wings with a white line	6.
„ without „	10. *localis.*
6. Second line of fore wings perpendicular to inner margin	9. *liodyta.*
Second line of fore wings rather strongly oblique	8. *monogona.*

4. *Omiodes Blackburni*, Butl.

Botys Blackburni, Butl., Ent. Mo. Mag., xiv., 48.

♂, 30 mm. Antennal ciliations one-fourth. Abdomen pale ochreous, segmental margins white. Fore wings pale brownish-ochreous, veins ochreous-whitish, separated at origin by a dark fuscous suffusion; an ochreous-whitish line, acutely angulated outwards in middle, from one-fourth of costa to one-third of inner margin, posteriorly margined with dark fuscous, anteriorly by a broad dark fuscous suffusion between veins; an ochreous-whitish transverse discal spot; an ochreous-whitish line from three-fourths of costa to three-fifths of inner margin, sinuate outwards beneath costa, below middle forming an acute triangular projection outwards, anteriorly margined with dark fuscous, posteriorly by a broad dark fuscous suffusion between veins; a slender interrupted dark fuscous hind-marginal streak; cilia whitish-ochreous, with a fuscous line. Hind wings rather densely haired towards inner margin; pale whitish-fuscous; an indistinct darker discal spot; a cloudy whitish line from two-thirds of costa to anal angle, with an acute projection outwards in middle, anteriorly narrowly, posteriorly broadly suffusedly margined with dark grey; a slender dark grey hind-marginal streak; cilia whitish, with a dark grey line.

Two specimens.

5. *Omiodes accepta.*

Botys accepta, Butl., Ent. Mo. Mag., xiv., 49.

♂ ♀, 22—31 mm. Antennal ciliations one-third. Abdomen fuscous, segmental margins white, anal segment with two blackish marks. Fore wings fuscous, darkest on costa towards base; veins whitish or whitish-ochreous; a dark fuscous dot towards costa at one-third, and a second (sometimes obsolete) in disc above middle; a dark fuscous fascia from beneath costa at three-fifths to one-third

of inner margin, interrupted partially by veins, its anterior edge well-defined and preceded by an obscure ochreous-whitish line, slightly concave, posterior edge suffused; a nearly straight or faintly sinuous ochreous-whitish line from costa before apex to three-fifths of inner margin, anteriorly finely margined with dark fuscous, posteriorly followed by a rather broad dark fuscous suffusion; a thick interrupted blackish-fuscous hind-marginal line; cilia fuscous-whitish, with two fuscous lines, second sometimes suffused and obscure. Hind wings fuscous-grey; a transverse darker discal mark at one-third; a rather irregular nearly straight cloudy whitish line from costa at three-fourths to anal angle, preceded by a narrow and followed by a broader darker fuscous suffusion; hind-marginal line and cilia as in fore wings.

Eight specimens.

6. *Omiodes continuatalis*, Wallgr.

Salbia continuatalis, Wallgr., Wien. Ent. Mon., 1860, 175; *Botys continuatalis*, Butl., Ent. Mo. Mag., xv., 270.

♂ ♀, 27—31 mm. Antennal ciliations one-fourth. Abdomen light greyish-fuscous, becoming blackish-grey posteriorly, segmental margins white. Fore wings rather dark fuscous; a narrow white central longitudinal streak from base to near middle; a slender white longitudinal streak in disc above middle from one-third to two-thirds, sometimes obscure; sometimes a dark fuscous dot in disc at one-third, and another in middle, especially in female; a strong nearly straight white line from immediately beneath costa at three-fourths to inner margin at two-thirds, thence slenderly produced along inner margin to one-third, sinuate inwards below middle, anteriorly edged with darker; a whitish irroration forming an obscure hind-marginal border; a thick interrupted blackish-fuscous hind-marginal line; cilia fuscous-whitish, with a thick fuscous line. Hind wings fuscous; an obscure darker discal spot at one-third; a strong nearly straight white line from beneath costa at two-thirds to anal angle, slightly sinuate near lower extremity, preceded by a cloudy dark fuscous line; a thick blackish-fuscous hind-marginal line; cilia white, with a dark fuscous line.

Twenty specimens. I took it commonly near Honolulu in August.

7. *Omiodes demaratalis*, Walk.

Botys demaratalis, Walk., 1009.

♂ ♀, 21—24 mm. Antennal ciliations one-fourth. Abdomen light ochreous, segmental margins white. Fore wings yellowish-ochreous, more or less tinged with reddish or brownish; costa suffused with rather dark fuscous from base to three-fourths; a dark fuscous dot in disc at two-fifths, and a small transverse-linear dark fuscous mark beyond middle; an almost straight white line from beneath costa at three-fourths to inner margin at two-thirds, anteriorly margined with dark fuscous; a hind-marginal row of blackish dots; cilia grey-whitish, with a grey line. Hind wings whitish-fuscous, towards hind margin becoming pale ochreous; a dark grey transverse discal mark at one-third; a strong white line from beneath costa beyond middle to anal angle, margined anteriorly with dark fuscous; an interrupted blackish hind-marginal line; cilia white, with a grey line.

Sixteen specimens. I took this with the last.

8. *Omiodes monogona*, n. s.

♀, 26 mm. Head, palpi, antennæ, and thorax fuscous, palpi white towards base beneath. Abdomen fuscous; segmental margins slenderly whitish. Legs ochreous-whitish, anterior pair infuscated. Fore wings elongate-triangular, costa arched posteriorly, apex obtuse, hind margin rather obliquely rounded; fuscous, irrorated with darker; a dark fuscous line from one-fourth of costa to one-third of inner margin, bent outwards in middle, preceded by some whitish scales; a blackish dot in disc at two-fifths, and a transverse-linear blackish mark beyond middle; a cloudy whitish line from two-thirds of costa to three-fifths of inner margin, thickest beneath, anteriorly suffusedly margined with dark fuscous, moderately curved outwards, below middle with an obtuse subtriangular projection inwards to below discal mark; a hind-marginal row of cloudy blackish-fuscous dots; cilia fuscous-whitish, with a fuscous line (imperfect). Hind wings fuscous; a dark fuscous transverse discal mark at one-third; a cloudy whitish almost straight line from three-fifths of costa to anal angle, anteriorly suffusedly margined with dark fuscous, and posteriorly followed by a broader dark suffusion; an interrupted blackish-fuscous hind-marginal line; cilia as in fore wings.

One specimen, in indifferent condition.

9. *Omiodes liodyta*, n. s.

♀, 17—20 mm. Differs from *O. monogona*, especially by the different form of the second line, which in fore wings is somewhat more curved on upper half, projection inwards beneath discal mark deeper and more rectangular, thence slightly curved but nearly perpendicular to inner margin, whilst in *O. monogona* it is rather strongly oblique; in hind wings slightly sinuate inwards on lower half; cilia of fore wings whitish-fuscous. It is also a considerably smaller insect, and smoother-looking. Possibly the males may show more pronounced differences.

Two specimens.

10. *Omiodes localis*, Butl.

Botys localis, Butl., Ent. Mo. Mag., xv., 271.

♂ ♀. 17—23 mm. Antennal ciliations one-third. Abdomen light fuscous, segmental margins whitish. Fore wings light fuscous; a dark fuscous line from one-fourth of costa to one-third of inner margin, angulated in middle, upper half indistinct, lower half well-marked; a dark fuscous dot in disc at two-fifths, and a transverse-linear mark beyond middle; a dark fuscous partially indistinct line, followed by a band slightly paler than ground colour, from two-thirds of costa to three-fifths of inner margin, upper half unevenly but moderately strongly curved outwards, the paler band followed by a somewhat darker suffusion; an interrupted blackish hind-marginal line; cilia whitish-fuscous, with a dark fuscous line. Hind wings light fuscous; an obscure darker transverse discal mark at one-third; a cloudy darker fuscous line from three-fifths of costa to inner margin above anal angle, rather bent in middle, beneath this rather irregular; a dark fuscous hind-marginal line; cilia whitish, with a dark fuscous line.

Seven specimens.

5. Zinckenia, *Z.*

11. *Zinckenia recurvalis*, F.

Hymenia fascialis, Cr., Butl., Ent. Mo. Mag., xvii., 9.

This species occurs now throughout the tropical and warmer temperate regions of the whole world, yet, in my experience, always in the immediate neighbourhood of civilisation, frequenting waste weedy ground in or near towns, especially on the coast. I think there can

be no doubt that its range is largely due to incidental introduction by man in company with subtropical weeds.

6. Scopula, *Schrk.*

1. Fore wings with ground colour ochreous .. .. 2.
   „ „ „ fuscous .. .. 3.
2. Fore wings with white markings .. .. .. 12. *eucrena.*
   „ without „ .. .. .. 19. *despecta.*
3. Fore wings with three transverse blotches .. 13. *monticolans.*
   „ without „ „ .. .. 4.
4. Fore wings with posterior half of costa spotted with whitish-ochreous and dark fuscous .. 5.
   Fore wings with posterior half of costa not spotted with whitish-ochreous and dark fuscous .. 7.
5. Fore wings with two parallel ochreous-whitish transverse lines about one-fourth .. .. 6.
   Fore wings without two parallel ochreous-whitish transverse lines about one-fourth .. .. 16. *emmychioides.*
6. Fore wings with second line posteriorly margined with ochreous-whitish throughout .. .. 15. *nigrescens.*
   Fore wings with second line posteriorly margined with ochreous-whitish on costa only .. .. 14. *micacea.*
7. Fore wings with second line posteriorly margined with whitish dots .. .. 17. *stellata.*
   Fore wings with second line not posteriorly margined with whitish dots .. .. .. 18. *argoscelis.*

12. *Scopula eucrena*, n. s.

♂, 17 mm. Head light ochreous, orbits white. Palpi $2\frac{1}{3}$, ochreous irrorated with fuscous, towards base white. Antennæ whitish, annulated with dark fuscous, ciliations two-thirds. Thorax whitish, anteriorly reddish-ochreous. (Abdomen broken.) Legs dark fuscous ringed with white (posterior pair broken). Fore wings rather elongate-triangular, costa posteriorly gently arched, apex obtuse, hind margin obliquely rounded; reddish-ochreous, brownish-tinged; costal edge dark fuscous; a strong white line from one-third of costa to two-fifths of inner margin, posterior edge dilated in disc, preceded by a dark fuscous suffusion in disc; an irregular white line from three-fourths of costa towards anal angle, at three-fourths abruptly curved round to beneath middle of disc, thence acutely angulated and running to two-thirds of inner margin, abruptly dilated and fascia-like at upper extremity and on lower portion; space between these two lines on dorsal half suffused with white, with a few reddish-ochreous scales; a small rounded-triangular black-margined spot, reddish-ochreous beneath,

white above, touching first line; a similar-coloured reniform spot beyond middle, lower extremity touching angle of second line; space between these forming a quadrate white spot, touching costa above and white dorsal suffusion beneath; space between reniform spot and upper half of second line wholly suffused with dark fuscous, except on costa where is a white intermediate dot; second line followed by a dark fuscous suffusion towards costa and another on inner margin; a hind-marginal row of cloudy dark fuscous spots; cilia fuscous, barred with pale ochreous, bars interrupted by a grey line, costal cilia dark fuscous dotted with white. Hind wings ochreous-whitish, towards hind margin suffused with pale ochreous; two grey dots longitudinally placed in disc about one-third; a cloudy whitish anteriorly grey-margined line from two-thirds of costa to two-thirds of inner margin, middle third forming an irregular subquadrate projection outwards; a hind-marginal row of small dark fuscous spots; cilia whitish, obscurely barred with whitish-ochreous, with a light grey line.

One specimen.

13. *Scopula monticolans*, Butl.

Locastra monticolens (rect. *monticolans*), Butl., Trans. Ent. Soc. Lond., 1882, 84.

♀, 21 mm. Palpi 1¾. Fore wings elongate-triangular, costa posteriorly slightly arched, apex obtuse, hind margin rather obliquely rounded; rather dark fuscous, somewhat mixed with reddish-ochreous, especially towards anal angle; three irregular transverse prismatic whitish blotches; first extending from one-fourth of costa to two-fifths of inner margin, much narrowed at lower extremity, anterior edge angulated; second in disc before middle, nearly touching costa and reaching two-thirds across wing, touching first in middle; third from two-thirds of costa, reaching three-fifths across wing, posterior edge margined by an irregular subdentate blackish-fuscous line, indented beneath costa, where it is followed by some white scales; cilia fuscous, with a darker line. Hind wings fuscous, becoming darker towards hind margin; two darker dots obliquely placed in disc at two-fifths; cilia fuscous, terminal half whitish, obscurely barred with fuscous.

Two specimens. I have corrected Butler's name, which involves a bad solecism.

14. *Scoparia micacea*, Butl.

Aporodes micacea, Butl., Ann. Mag. Nat. Hist., 1881, 326.

♂ ♀, 19—22 mm. Palpi 1¼. Antennal ciliations one-half. Fore wings elongate-triangular, costa posteriorly slightly arched, apex obtuse, hind margin rather obliquely rounded; fuscous, slightly slaty-tinged; base suffused with dark fuscous; two nearly straight parallel ochreous-whitish lines from about one-fifth of costa to one-fourth of inner margin, slightly bent beneath costa, included space mixed with ochreous-whitish, fuscous, and reddish-ochreous, second followed by a moderately broad dark fuscous suffusion, forming an abrupt projection outwards in disc; a very small annular dark fuscous spot obscurely indicated on outer edge of this above middle; a moderately large reniform spot outlined with dark fuscous, somewhat mixed with reddish-ochreous, upper half dilated and containing a dark fuscous dot sometimes suffused into posterior margin; space in front of this spot in the male paler; posterior half of costal edge ochreous-whitish spotted with dark fuscous; a dark fuscous dentate line from three-fourths of costa to two-thirds of inner margin, moderately irregularly curved outwards, with a much stronger indentation below middle, on costa followed by a triangular whitish suffusion; some ochreous-whitish scales before hind margin towards middle; cilia fuscous, with faint indications of slender ochreous-whitish bars. Hind wings fuscous, darker in female, becoming dark fuscous towards hind margin; two small darker spots obliquely placed in disc at two-fifths; cilia fuscous, terminal half whitish barred with fuscous.

Fourteen specimens.

15. *Scoparia nigrescens*, Butl.

Mecyna nigrescens, Butl., Ann. Mag. Nat. Hist., 1881, 328; *Melanomecyna nigrescens*, id., Ent. Mo. Mag., xix., 179.

♂ ♀, 14—17 mm. Palpi two. Antennal ciliations one-half. Fore wings rather elongate-triangular, costa posteriorly slightly arched, apex obtuse, hind margin rather obliquely rounded; light fuscous, ochreous-tinged; two nearly straight parallel ochreous-whitish lines from before one-fourth of costa to one-fourth of inner margin, confluent in disc, second margined posteriorly by a blackish line, less marked towards costa, sometimes rather broadly suffused beneath; a subquadrate spot suffused with ochreous-

whitish in disc above middle, its lateral margins incurved and edged with blackish; a moderate reniform spot adjoining this posteriorly, partially blackish-edged and bisected horizontally by a dark fuscous suffusion, posteriorly margined by an ochreous-whitish crescentic suffusion; a blackish rather irregular line, stronger and subdentate beneath, posteriorly edged with ochreous-whitish, from three-fourths of costa towards anal angle, below middle abruptly curved round to beneath reniform spot, thence rectangularly bent to inner margin at two-thirds; sometimes the median space forms a distinct darker band; posterior half of costal edge ochreous-whitish spotted with dark fuscous; a more or less indicated irregular cloudy ochreous-whitish submarginal line, most distinct in middle; a hind-marginal series of small dark fuscous spots; cilia ochreous-whitish barred with pale fuscous, with a fuscous basal line. Hind wings fuscous, with a darker tolerably defined hind-marginal band; two darker dots obliquely placed in disc before middle; cilia whitish, with a fuscous basal line.

Twenty specimens.

16. *Scopula ennychioides*, Butl.

Mecyna ennychioides, Butl., Ann. Mag. Nat. Hist., 1881, 328; *Melanomecyna ennychioides*, id., Ent. Mo. Mag., xix., 179.

♂ ♀, 21—22 mm. Palpi three. Antennal ciliations two-thirds Fore wings rather elongate-triangular, costa posteriorly gently arched, apex obtuse, hind margin moderately bowed, oblique; fuscous; costa, base, and lower half of median band suffusedly darker; a blackish-fuscous line from one-fifth of costa to two-fifths of inner margin, rather bent outwards in middle, shortly indented inwards at one-fourth and three-fourths; a rounded-triangular darker spot, edged with blackish-fuscous, in disc before middle, not touching first line; a similar-coloured reniform spot beyond middle; space round these rather paler than ground colour; a rather irregular blackish-fuscous line, posteriorly obscurely edged with whitish-ochreous, from three-fourths of costa towards anal angle, indented beneath costa, below middle abruptly bent inwards to beneath reniform, thence again abruptly bent to inner margin at two-thirds, lower portion subdentate; posterior half of costal edge whitish-ochreous spotted with dark fuscous; a hind-marginal series of small triangular dark fuscous spots, separated with whitish-ochreous, and margined anteriorly by a fine obscure whitish-ochreous waved line; cilia fuscous, obscurely barred with

whitish-ochreous, with a dark fuscous line near base. Hind wings in male rather dark fuscous; in female whitish-fuscous, more whitish towards costa; two darker dots obliquely placed in disc before middle; a rather irregular curved darker line at two-thirds, followed by a paler line; hind-marginal markings in female as in fore wings, in male obscured; cilia fuscous, on posterior half whitish.

Three specimens. The differences in the colour of the hind wings are perhaps not sexual, but merely due to individual variation.

17. *Scopula stellata*, Butl.

Melanomecyna stellata, Butl., Ent. Mo. Mag., xix., 179.

♂ ♀, 17—19 mm. Palpi 2½. Antennal ciliations three-fourths. Fore wings rather elongate-triangular, costa posteriorly moderately arched, apex obtuse, hind margin bowed, oblique; fuscous; costa suffusedly dark fuscous; a rather irregular dark fuscous line from one-fourth of costa to one-third of inner margin, somewhat bent outwards in middle; a very small roundish dark fuscous spot in disc before middle; a dark fuscous reniform spot beyond middle; space between these slightly paler than ground colour; a cloudy dark fuscous line, margined posteriorly with indistinct whitish dots, from three-fourths of costa towards anal angle, moderately curved, beneath middle obtusely bent inwards to below reniform, thence tolerably rectangularly bent to inner margin at two-thirds; a hind-marginal series of small dark fuscous spots, separated by whitish dots, sometimes obsolete; cilia fuscous, terminal half very obscurely barred with whitish. Hind wings fuscous; two indistinct darker dots obliquely placed before middle; cilia fuscous, terminal half fuscous-whitish.

Four specimens. The specimens standing as *Scotomera tristis*, Butl., in the British Museum appear to be identical with this species, but are too worn to be certainly recognised.

18. *Scopula argoscelis*, n. s.

♂ ♀, 22—25 mm. Head, palpi, antennæ, thorax, and abdomen fuscous; palpi 3½, white at base beneath; antennal ciliations two-thirds. Legs white, anterior tibiæ dark fuscous above, posterior pair fuscous beneath. Fore wings rather elongate-triangular, costa posteriorly gently arched, apex obtuse, hind margin bowed, oblique; fuscous, tinged with reddish-ochreous towards inner margin near

base; an irregular cloudy dark fuscous line from one-fourth of costa to two-fifths of inner margin, rather bent in middle; a very small darker spot in disc before middle, sometimes obsolete; an obscure darker fuscous reniform spot beyond middle; a cloudy waved dark fuscous line from three-fourths of costa towards anal angle, moderately curved, beneath middle obtusely bent inwards to below reniform, thence rectangularly bent to inner margin at two-thirds; a hind-marginal series of obscure dark fuscous dots; cilia pale fuscous, with a darker line, tips more whitish (imperfect). Hind wings fuscous; two obscure darker dots obliquely placed in disc before middle; a hind-marginal series of dark fuscous dots or cloudy interrupted line; cilia whitish, with a fuscous line.

Three specimens.

19. *Scopula despecta*, Butl.

Rhodaria despecta, Butl., Ent. Mo. Mag., xiv., 49; *Scopula exigua*, ib., xvii., 9.

♂ ♀, 17—18 mm. Palpi three. Antennal ciliations one-half. Fore wings rather elongate-triangular, costa posteriorly gently arched, apex obtuse, hind margin obliquely rounded; ochreous, sometimes slightly brownish or reddish-tinged; costa suffusedly darker anteriorly; an indistinct slightly curved fuscous line from one-fifth of costa to two-fifths of inner margin; a small roundish spot faintly outlined with fuscous in disc before middle; a reniform spot more distinctly outlined with fuscous beyond middle; a rather irregular fuscous line from three-fourths of costa towards anal angle, somewhat curved, slightly indented beneath costa, below middle abruptly bent inwards to beneath reniform spot, thence tolerably rectangularly bent to two-thirds of inner margin; a hind-marginal row of blackish dots, sometimes nearly obsolete; cilia whitish, with a grey line. Hind wings whitish fuscous, more or less suffused with darker fuscous-grey towards apex; two darker fuscous dots obliquely placed in disc before middle; a hind-marginal series of dark fuscous dots, sometimes pale-margined; cilia whitish, with a faint ochreous-grey basal line.

Twenty-four specimens. Larva described by Mr. Blackburn, Ent. Mo. Mag., xix., 56.

7. PROTOCOLLETIS, n. g.

Forehead rounded, slightly prominent. Ocelli present. Tongue well-developed. Antennæ three-fourths, in male filiform, moderately ciliated (two-thirds), rough-scaled on back. Labial palpi

very long, straight, porrected, clothed with dense rough scales diminishing to apex, terminal joint moderate, partially concealed. Maxillary palpi moderate. terminally dilated with scales. Abdomen in male with moderate anal tuft, valves exserted. Posterior tibiæ with outer middle-spur one-half, outer end-spur three-fourths of inner. Fore wings with veins 8 and 9 stalked, 10 anastomosing shortly with 9 near base, 11 moderate, oblique. Hind wings as broad as fore wings; veins 4 and 5 short-stalked, 7 out of 6 near origin, anastomosing with 8 to near middle.

Allied to *Scopula*, but with all spurs of tibiæ developed; it differs from all genera of this group, and indeed perhaps all Pyrales, in the neuration of the fore wings, in which vein 10 anastomoses with 9, as it usually does in the *Noctuina*.

20. *Protocolletis constricta*, Butl.

Scopula constricta, Butl., Trans. Ent. Soc. Lond., 1882, 40.

♂ ♀, 20—22 mm. Palpi five. Fore wings elongate-triangular, costa gently arched, faintly sinuate, apex tolerably rectangular, hind margin bowed, oblique; rufous; a dark fuscous dot beneath costa at one-fourth; a small roundish spot outlined with darker in disc before middle; a nearly straight dark fuscous line from anterior edge of this to two-fifths of inner margin, preceded by a more or less marked whitish-ochreous suffusion; a reniform spot outlined with dark fuscous beyond middle; an indistinct waved dark fuscous line from three-fourths of costa towards anal angle, indented beneath costa, below middle curved inwards to beneath reniform spot, thence tolerably rectangularly bent to two-thirds of inner margin, lower portion posteriorly suffusedly margined with whitish ochreous, sometimes margined with small whitish-ochreous lunules throughout; a subterminal series of faint pale marks; a hind-marginal series of black dots, connected by a faint pale line; cilia rufous, with a dark grey basal line. Hind wings light fuscous, suffused with ochreous-whitish towards costa, becoming rather darker posteriorly; two rather large dark fuscous dots obliquely placed in disc before middle; an obscure waved curved ochreous-whitish line, preceded by a darker line, about three-fourths, parallel to hind margin; a hind-marginal series of black dots margined and connected with ochreous-whitish; cilia reddish-whitish, basal third dark grey barred with ochreous-whitish.

Three specimens.

8. Mecyna, *Gn.*

Hind wings with dark fuscous hind-marginal border .. 22. *virescens.*
" without " " " .. 21. *aurora.*

21. *Mecyna aurora*, Butl

Anemosa aurora, Butl., Ann. Mag. Nat. Hist., 1881, 327.

♂, 17 mm. Palpi three. Antennal ciliations one-third. Middle tibiæ much dilated, with pencil of white hairs in groove. Fore wings rather elongate-triangular, costa slightly arched, apex obtuse, hind margin obliquely rounded; ochreous-reddish, slightly purplish-shining, towards base and costa deeper and more purple-reddish; a faint darker outwards-curved line from three-fourths of costa to two-thirds of inner margin, sinuate beneath costa, below middle rectangularly indented inwards; cilia ochreous-yellowish, tips paler. Hind wings ochreous-yellowish: an obscure hind-marginal band reddish-tinged; two faint grey dots obliquely placed in disc before middle; cilia ochreous-whitish, towards base more ochreous and reddish-tinged.

Two specimens.

22. *Mecyna virescens*, Butl.

Mecyna virescens, Butl., Ann. Mag. Nat. Hist., 1881, 329.

♂ ♀, 26—33 mm. Palpi $3\frac{1}{2}$. Antennal ciliations one. Middle tibiæ of male moderate, grooved, without hair-pencil. Fore wings elongate-triangular, costa posteriorly gently arched, apex obtuse, hind margin somewhat bowed, rather oblique; variable, brownish-ochreous, reddish-ochreous, or pale greyish-ochreous mixed with reddish-fuscous, sometimes finely sprinkled with black; a nearly straight cloudy darker line, sometimes preceded by a pale line, from one-fifth of costa to before middle of inner margin; a small round cloudy darker spot in disc before middle, and a somewhat larger subquadrate or transverse spot beyond middle; obliquely beneath and beyond this is a cloudy roundish similar spot, sometimes larger and conspicuously blackish, always perceptible; a strongly curved cloudy darker line, sometimes followed by a pale line, generally marked with a series of black dots, from before three-fourths of costa to three-fifths of inner margin, indented beneath costa, below middle with a rectangular indentation inwards touching third discal spot; cilia greyish-ochreous or

reddish-ochreous, tips paler, sometimes with an obscure darker line. Hind wings ochreous-yellowish, almost or quite wholly suffused with pale fuscous; generally a small suffused dark fuscous spot in middle of disc, and sometimes another smaller and fainter obliquely above and before it; a moderate cloudy dark fuscous hind-marginal band, slightly dilated at apex and above anal angle, suddenly ceasing before reaching anal angle; cilia yellow-ochreous, tips paler.

Fourteen specimens. Probably nearest *M. deprivalis*, from Ceylon and New Zealand.

9. Orthomecyna, *Butl.*

Forehead rounded, vertical. Ocelli present. Tongue well-developed. Antennæ three-fourths, in male filiform, shortly ciliated (one-third), rough-scaled on back. Labial palpi moderately long, porrected, second joint with dense rough projecting scales beneath, longer and almost tufted towards apex, terminal joint concealed. Maxillary palpi moderate, terminally dilated with scales, truncate. Abdomen in male with moderately large anal tuft, valves exserted. Posterior tibiæ with all spurs moderately long, nearly equal. Fore wings with veins 8 and 9 stalked, 11 moderately oblique. Hind wings as broad as fore wings; veins 4 and 5 stalked, 7 rising separate from 6, connected with 8 at a point only near origin, lower median with well-defined pectination; in male with vein 3 absent, on upper surface with a longitudinal hairy grooved fold from base beneath lower median above vein 1*a* to hind margin.

A special endemic development, most allied to *Mecyna*.

1. Fore wings ochreous-brown	.. ..	23. *albicaudata.*
,, greyish	.. ..	2.
2. Fore wings with lines tolerably distinct, blackish	..	24. *exigua.*
,, ,, imperceptible	.. .. ..	25. *aphanopis.*

23. *Orthomecyna albicaudata*, Butl.

Orthomecyna albicaudata, Butl., Ent. Mo. Mag., xix., 178.

♂ ♀, 18—23 mm. Abdomen brownish-ochreous, in male becoming ochreous-white posteriorly. Fore wings elongate-triangular, costa almost straight, apex obtuse, hind margin rather obliquely rounded; ochreous, irrorated with ochreous-brown; two hardly traceable darker lines, first from two-fifths of costa to middle of inner margin, almost straight, second from three-fifths

of costa to three-fifths of inner margin, upper half forming a strong curve outwards; a small obscure darker spot in disc beyond middle between these, in female more distinct; in one specimen (female) a whitish-ochreous suffusion on dorsal half beyond middle, preceded and followed by cloudy rather dark fuscous suffusions; a submarginal series of indistinct darker spots; cilia brownish, with an obscure darker line. Hind wings blackish-fuscous; two ill-defined ochreous-yellow gradually dilated streaks from base to near hind margin, one above, other below middle, more or less strongly expanded in disc; cilia ochreous-yellow, tips paler, with an indistinct incomplete grey line.

Four specimens.

24. *Orthomecyna exigua*, Butl.

Mecyna exigua, Butl., Ent. Mo. Mag., xv., 271; Ann. Mag. Nat. Hist., 1881, 329; *Orthomecyna exigua*, var. *cupreipennis*, id., Ent. Mo. Mag., xix., 179.

♂ ♀, 14—23 mm. Abdomen greyish-ochreous, yellowish-tinged. Fore wings elongate-triangular, costa hardly arched, apex obtuse, hind margin rather obliquely rounded; pale greyish-ochreous, irrorated with dark grey; an angulated blackish line near base, sometimes obsolete; an irregular blackish line from one-fourth of costa to about middle of inner margin, more or less indented outwards above middle, sometimes preceded by a pale or whitish line; an angulated black mark in disc beyond middle, angle directed towards base; a slender waved blackish line, followed by a pale line, from two-thirds of costa to two-thirds of inner margin, upper two-thirds moderately curved outwards; a more or less distinct cloudy pale subterminal line, followed by a series of darker spots; a hind-marginal series of triangular dark grey spots; cilia pale greyish-ochreous, with a cloudy dark grey basal line. Hind wings dark grey; two more or less distinct very ill-defined ochreous-yellowish longitudinal suffusions above and below middle, extending from near base to about three-fourths; cilia ochreous-yellowish, tips paler, with a cloudy grey basal line.

Sixteen specimens.

25. *Orthomecyna aphanopis*, n. s.

♂ ♀, 15—18 mm. Abdomen yellow-ochreous. Fore wings elongate-triangular, costa nearly straight, apex obtuse, hind margin rather obliquely rounded; whitish-grey, somewhat mixed with pale greyish-ochreous and darker grey; lines hardly perceptible;

an indistinct grey angulated mark in disc beyond middle; a submarginal series of indistinct darker spots; a dark grey hind-marginal line; cilia light grey, with a darker line. Hind wings pale yellowish-ochreous or greyish-ochreous, generally suffused with grey towards hind margin and longitudinally in disc; a dark grey hind-marginal line; cilia ochreous-grey-whitish, towards base sometimes suffused with grey, or with a darker line.

Three specimens.

10. Mestolobes, *Butl.*

Forehead rounded, oblique. Ocelli present. Tongue well-developed. Antennæ three-fourths, in male filiform, moderately ciliated (one-half), rough-scaled on back, basal joint stout. Labial palpi moderate, tolerably porrected, second joint with dense broadly projecting scales beneath, terminal joint rather short, projecting or concealed. Maxillary palpi moderate, terminally dilated with scales, truncate. Abdomen in male with moderately large anal tuft, sometimes with lateral tufts near apex, valves exserted. Middle and posterior tibiæ in male sometimes with tufts; posterior tibiæ with outer spurs two-thirds to four-fifths of inner. Fore wings with veins 8 and 9 stalked, 11 moderately oblique. Hind wings as broad as fore wings; vein 3 absent, 4 and 5 stalked, 7 out of 6 near origin, anastomosing with 8 to near one-third; in male with a narrow lobe from base of inner margin, densely clothed with rough hairs or with an apical tuft of hairs, and generally with a pencil of hairs along costa from base.

Certainly a further development of *Orthomecyna*. The various singular tufts and hair-pencils of this genus are specific characters only, not generic.

1. Hind wings partially white or whitish	.. ..	26. *abnormis*.
,, not ,, ,,	.. ..	2.
2. Hind wings ochreous-yellow except apex	.. ..	27. *semiochrea*.
,, ,, only on costa in male		28. *minuscula*.

26. *Mestolobes abnormis*, Butl.

Metasia abnormis, Butl., Trans. Ent. Soc. Lond., 1882, 35 (♀); *Mestolobes œnone*, ib., 37 (♂).

♂ ♀, 14—15 mm. Abdomen dark grey, in male ochreous-whitish towards base and apex. Legs white, anterior and middle pair partially banded with blackish, posterior tibiæ in male with brush of black scales above on terminal half. Fore wings oblong,

posteriorly somewhat dilated, costa anteriorly slightly arched, apex obtuse, hind margin obliquely rounded; pale fuscous, irregularly mixed with whitish-ochreous, yellowish, and blackish; an irregular obscure whitish line from one-third of costa to two-fifths of inner margin, rather angulated in middle; a similar more strongly angulated line from four-fifths of costa to inner margin before anal angle; a small irregular suffused dark fuscous spot in disc beyond middle; cilia mixed with ochreous-whitish and dark fuscous (imperfect). Hind wings in male white, faintly ochreous-tinged, with a blackish blotch occupying apical third; in female dark fuscous, with a whitish suffusion towards middle of disc and base of costa; costa in male with longitudinal pencil of yellowish hairs in groove; inner-marginal lobe in male strong, hollowed, terminating in two tufts of black scales; cilia white, with a blackish line, in male round apex only.

Six specimens. There is not the least doubt as to the specific identity of the sexes, referred by Butler to separate families.

27. *Mestolobes semiochrea*, Butl.

Mestolobes semiochrea, Butl., Trans. Ent. Soc. Lond., 1882, 39.

♂, 18 mm. Abdomen whitish-ochreous. Legs whitish-ochreous, anterior pair banded with dark fuscous, posterior tibiæ with an obliquely erect tuft of coarse black scales from above near base. Fore wings oblong, posteriorly somewhat dilated, costa anteriorly slightly arched, apex obtuse, hind margin obliquely rounded; whitish-ochreous, sprinkled with fuscous, suffused with ochreous-fuscous except on basal third and a small costal blotch before second line; lines obscure, whitish-ochreous, darker-margined, first from two-fifths of costa to middle of inner margin, almost straight, anterior edge marked with blackish, second from four-fifths of costa to inner margin before anal angle, upper two-thirds moderately curved outwards; cilia whitish-ochreous mixed with fuscous, with a cloudy darker fuscous line (imperfect). Hind wings ochreous-yellow; a narrow dark fuscous streak along upper half of hind margin; costa without hair-pencil; inner-marginal lobe short, hairy; cilia pale yellowish, on upper half of hind margin with a basal grey line.

Two specimens.

28. *Mestolobes minuscula*, Butl.

Boreophila minuscula, Butl., Ann. Mag. Nat. Hist., 1881, 325; *Mestolobes simæthina*, id., Trans. Ent. Soc. Lond., 1882, 38.

♂ ♀, 10—14 mm. Abdomen dark fuscous, towards base in male ochreous-yellowish. Legs whitish-ochreous, anterior and middle pair banded with dark fuscous, posterior tibiæ without tuft. Fore wings oblong-triangular, costa hardly arched, apex obtuse, hind margin obliquely rounded; fuscous, mixed with dark fuscous; lines obscure or tolerably distinct, fuscous-whitish, obscurely darker-margined; first from one-third of costa to two-fifths of inner margin, often distinctly double, somewhat angulated in middle; second from three-fourths of costa to three-fourths of inner margin, unevenly curved outwards; immediately beyond first line ground colour somewhat ochreous-tinged; an ochreous-tinged dark-margined reniform spot in disc beyond middle; an interrupted dark fuscous hind-marginal line; cilia pale greyish-ochreous, with a dark fuscous line near base and cloudy fuscous posterior line. Hind wings rather dark fuscous, darker in female, especially towards hind margin; in male with an ochreous-yellowish patch along basal two-thirds of costa, including a longitudinal pencil of yellowish hairs in a shallow groove; inner-marginal lobe in male clothed with dense light ochreous-yellowish hairs; cilia grey-whitish, with a dark grey line.

Sixteen specimens.

11. Eurycreon, *Ld.*

29. *Eurycreon litorea*, Butl.

Scopula litorea, Butl., Ent. Mo. Mag., xix., 178.

♂, 15 mm. Frontal projection obtuse, rounded. Palpi 3½. Antennal ciliations one. Fore wings elongate-triangular, costa posteriorly gently arched, apex obtuse, hind margin obliquely rounded; whitish-ochreous, sprinkled with brownish-ochreous; lines barely indicated by a few scattered blackish scales, but not traceable; cilia whitish-ochreous. Hind wings ochreous-whitish, somewhat sprinkled with ochreous-brownish; a very indistinct line indicated by dark fuscous scales at three-fourths parallel to hind margin; sometimes a series of obscure fuscous hind-marginal dots; cilia ochreous-whitish.

Three specimens. One of the specimens in the British Museum appears to have fine but distinct first

and second lines of the usual form. The long palpi are a good specific point.

SCOPARIADÆ.

Hind wings with some long hairs in disc within cell ..	13. XEROSCOPA.
„ without „ „ „ ..	12. SCOPARIA.

12. SCOPARIA, *Hw.*

Fore wings with orbicular and reniform indicated by black marks	31. *frigida.*
Fore wings with orbicular and reniform not black ..	30. *macrophanes.*

30. *Scoparia macrophanes*, n. s.

♀, 17 mm. Head, palpi, and thorax white mixed with fuscous; palpi three, with an oblique dark fuscous median band, base wholly white. Antennæ grey. Abdomen light fuscous. Legs dark grey, banded with white. Fore wings elongate, narrow, posteriorly gradually dilated, costa posteriorly slightly arched, apex obtuse, hind margin nearly straight, oblique, rounded beneath; fuscous-grey, densely mixed with white, with scattered dark fuscous scales; an indistinct oblique transverse darker line near base; first line cloudy, white, followed by a cloudy darker grey suffusion, moderately oblique, slightly curved, shortly abruptly indented in middle; orbicular indicated by a cloudy slightly darker detached suffusion; claviform obsolete; reniform cloudy, 8-shaped, darker grey, preceded by a white suffusion; second line slender, white, indistinct, moderately curved, moderately indented beneath costa and sinuate above inner margin; hind-marginal area beyond this darker grey; subterminal line cloudy, whitish, touching second in middle; a hind-marginal row of cloudy whitish dots; cilia whitish, with a dark grey line near base, and cloudy grey post-median line. Hind wings 1½; pale whitish-grey, thinly scaled; apex narrowly suffused with darker grey; a cloudy dark grey hind-marginal line; cilia grey-whitish, with a dark grey line.

One specimen. *S. angustea* (*coarctata*), erroneously recorded by Butler, was identified either from this or the following species.

31. *Scoparia frigida*, Butl.

Scoparia frigida, Butl., Ann. Mag. Nat. Hist., 1881, 331; *S. montana*, id., Trans. Ent. Soc. Lond., 1882, 41.

♂ ♀, 17—19 mm. Head white. Palpi three, dark fuscous, mixed with white above, base white, apex of maxillary palpi white.

Antennæ grey, ciliations in male two-thirds. Thorax fuscous, mixed with white. Abdomen pale greyish-ochreous. Legs dark grey, banded with white. Fore wings elongate, narrow, posteriorly gradually dilated, costa hardly arched, apex obtuse, hind margin nearly straight, oblique, rounded beneath; fuscous or ochreous-fuscous, irregularly mixed with white; some scattered black scales tending to accumulate on veins, and especially along submedian fold; first line cloudy, whitish, followed by some black scales, very oblique, slightly curved, slightly indented in middle; orbicular represented by a detached short sinuate longitudinal blackish mark, sometimes obscure; claviform obsolete; reniform formed by two white dots, separated by an obscure X-shaped blackish mark; second line slender, whitish, abruptly curved in middle, acutely indented beneath costa, rather strongly sinuate above inner margin; subterminal cloudy, whitish, almost straight, touching second line in middle; a white hind-marginal line, preceded by a series of cloudy black dots, extreme hind-marginal edge blackish; cilia white, base ochreous-tinged, with a blackish somewhat interrupted line near base, and a grey post-median line. Hind wings $1\frac{1}{3}$; pale whitish-fuscous, in male paler, rather darker towards apex; a cloudy fuscous hind-marginal line; cilia white, with a fuscous line.

Four specimens. Packard has described a species under the name of *Scoparia frigidella*, but it is probably a variety of *S. centuriella*; otherwise Butler's first name would lapse.

13. Xeroscopa, *Meyr.*

1. Fore wings with ground colour white or ochreous-white	2.
Fore wings with ground colour fuscous or grey ..	5.
2. Reniform connected with orbicular	3.
„ separate from orbicular	4.
3. Thorax black, with two white lines	38. *pachysema.*
„ white, shoulders black	40. *formosa.*
4. Fore wings with basal area wholly black	39. *mesoleuca.*
„ „ a narrow black subbasal fascia ..	41. *jucunda.*
5. Fore wings with all veins lined with white	32. *venosa.*
„ „ „ not lined with white ..	6.
6. Head wholly ochreous-whitish	37. *hawaiensis.*
„ more or less fuscous	7.
7. Hind wings fuscous	34. *ombrodes.*
„ pale whitish-fuscous	8.
8. Claviform defined	9.
„ absent	35. *demodes.*
9. Fore wings with blackish spot near base in middle	36. *ischnias.*
„ without „ „ „	33. *melanopis.*

32. *Xeroscopa venosa*, Butl.

Scoparia venosa, Butl., Ann. Mag. Nat. Hist., 1881, 332.

♂, 17—19 mm. Head white, slightly mixed with fuscous. Palpi three, rather dark fuscous, upper edge and base beneath white. Antennæ grey, ciliations three-fourths. Thorax fuscous, sprinkled with white. Abdomen light greyish-ochreous. Legs white, sprinkled with dark fuscous, base of joints dark fuscous, anterior pair dark fuscous ringed with white. Fore wings elongate, narrow, gradually dilated, costa hardly arched, apex obtuse, hind margin oblique, nearly straight, rounded beneath; fuscous, irrorated with dark fuscous; all veins more or less distinctly lined with white; first line indistinctly indicated, hardly darker fuscous; orbicular and claviform nearly obsolete, indicated by two or three dark fuscous scales; reniform indicated by a small bent longitudinal dark fuscous mark; second line faintly traceable; a submarginal line of small cloudy dark fuscous subconfluent dots; cilia white, with a dark fuscous line near base, and grey postmedian line. Hind wings 1½; very pale whitish-fuscous, apex hardly darker; a cloudy fuscous hind-marginal line; cilia whitish, with a fuscous line.

Three specimens.

33. *Xeroscopa melanopis*, n. s.

♀, 16 mm. Head and thorax fuscous-grey, sprinkled with whitish. Palpi 2½, rather dark fuscous, upper edge and base beneath white. Antennæ grey. Abdomen whitish-fuscous. Legs dark fuscous, banded with white, middle and posterior tibiæ suffused with white. Fore wings very elongate-triangular, costa posteriorly slightly arched, apex obtuse, hind margin slightly rounded, oblique; fuscous-grey, irrorated with white; first line slender, indistinct, whitish, posteriorly margined by an ochreous-brown suffusion irrorated with black, slightly curved; orbicular obsolete; claviform conspicuous, elongate, black, touching first line; reniform indicated by a small brown suffusion, extended to touch costa; second line very slender, indistinct, whitish; subterminal slender, cloudy, whitish, touching second line; a slender waved whitish hind-marginal line, preceded in middle by a rather darker suffusion; cilia whitish, with a dark grey line near base. Hind wings 1¼; pale whitish-fuscous, hind margin obscurely darker; cilia whitish, with a fuscous line.

One specimen. The conspicuous claviform spot is the most marked characteristic.

34. *Xeroscopa ombrodes*, n. s.

♀, 15—16 mm. Head and thorax rather dark fuscous, with a few ochreous-whitish scales. Palpi $2\frac{1}{2}$, dark fuscous, base ochreous-whitish. Antennæ dark fuscous. Abdomen dark grey, segmental margins grey-whitish. Legs dark grey, ringed with whitish. Fore wings very elongate-triangular, costa posteriorly gently arched, apex obtuse, hind margin rather obliquely rounded; rather light fuscous; an irregular suffused dark fuscous fascia near base; first line ochreous-whitish, slightly curved, preceded by a more obscure similar line, confluent in middle, and followed by a dark fuscous suffusion; space between first and second lines mixed with ochreous-whitish on costal third, rest sprinkled with dark fuscous; orbicular dot-like, dark fuscous, ill-defined beneath; claviform indicated by some undefined dark fuscous scales; reniform very ill-defined, small, dark fuscous, sometimes connected with orbicular by a suffused streak; second line ochreous-whitish, obsolete except towards inner margin; subterminal obsolete; a few dark fuscous scales towards hind margin; an irregular whitish hind-marginal line; cilia light fuscous, mixed and obscurely barred with white, with a dark fuscous line. Hind wings $1\frac{1}{2}$; fuscous, somewhat lighter towards base; cilia whitish-fuscous, with a fuscous line.

Two specimens, not in good condition.

35. *Xeroscopa demodes*, n. s.

♀, 17 mm. Head, palpi, and thorax whitish, mixed with ochreous-fuscous; palpi three, towards base white, with an oblique dark fuscous median band. Antennæ grey-whitish. Abdomen whitish-ochreous. Legs dark fuscous, ringed with whitish. Fore wings elongate-triangular, costa posteriorly slightly arched, apex obtuse, hind margin nearly straight, oblique, rounded beneath; light fuscous, irregularly mixed with white, and with a few dark fuscous scales, in disc mixed with yellowish-ochreous; a narrow cloudy oblique irregular dark fuscous basal fascia; a small ill-defined reddish-ochreous spot on posterior edge of this in middle; first line indistinct, whitish, somewhat curved, indented in middle, posteriorly margined by a blackish suffusion merging into ochreous-brown; orbicular represented by a few indefinite dark fuscous scales; claviform absent; reniform 8-shaped, suffusedly blackish-margined except above and beneath, ochreous-brown, lower half containing a white dot; second line whitish, preceded by a few dark fuscous scales, gently curved, sinuations below costa and above inner margin slight; subterminal cloudy, whitish, touching

second line in middle; some dark fuscous scales towards hind margin, tending to form very indistinct spots, dilated in middle; cilia ochreous-grey-whitish, basal half faintly barred with pale fuscous. Hind wings 1½; pale whitish-fuscous, apex hardly darker; cilia fuscous-whitish, with a pale fuscous line.

One specimen.

36. *Xeroscopa ischnias*, n. s.

♂, 18 mm. Head and thorax fuscous mixed with dark fuscous. Palpi two, dark fuscous, white towards base beneath, apex of maxillary palpi white. Antennæ grey, uniformly pubescent-ciliated over whole surface (four-fifths). Abdomen light fuscous. Legs dark fuscous, ringed with white. Fore wings elongate, narrow, gradually dilated, costa hardly arched, apex obtuse, hind margin nearly straight, oblique, rounded beneath; fuscous, irregularly mixed with white; base narrowly mixed with blackish; a small irregular blackish spot near base in middle, preceded by a white dot; first line cloudy, whitish, slightly indented in middle, posteriorly obscurely margined with dark fuscous; orbicular roundish, outlined with dark fuscous, very obscure, detached; claviform elongate-dot-like, dark fuscous, separated from first line by a whitish dot; reniform indicated by a very obscure dark fuscous X-shaped mark; a cloudy whitish suffusion preceding second line; second line whitish, obscurely margined with dark fuscous; hind-marginal area suffused with dark fuscous; subterminal cloudy, whitish, touching second line in middle; a waved white hind-marginal line; cilia light grey, sharply barred with white, with an interrupted dark fuscous line. Hind wings 1⅜; very pale whitish-fuscous, towards apex slightly darker, with a faint pale post-median line; cilia whitish, with a fuscous line.

One specimen. The peculiar pubescence of the antennæ is a noticeable character.

37. *Xeroscopa hawaiensis*, Butl.

Scoparia hawaiensis, Butl., Ann. Mag. Nat. Hist., 1881, 330.

♂ ♀, 14—21 mm. Head ochreous-whitish. Palpi 2¼, dark fuscous, towards apex and base ochreous-whitish. Antennæ grey, ciliations in male two-thirds. Thorax ochreous-whitish, sprinkled with dark fuscous on sides. Abdomen ochreous-grey-whitish. Legs blackish, banded with white. Fore wings very elongate-triangular, costa hardly arched, apex obtuse, hind margin nearly

straight, rather oblique, rounded beneath; fuscous, densely mixed with white, and with a few black scales; an ill-defined cloudy dark fuscous oblique fascia near base; first line very obscure, whitish, rather indented in middle, posteriorly margined by a moderately broad irregular dark fuscous fascia, in which claviform is indicated by an obscure blackish mark; orbicular dot-like, dark fuscous, touching preceding fascia; reniform 8-shaped, suffusedly blackish-margined, open above and beneath, above connected with costa by a dark fuscous spot; second line very obscurely whitish, margined anteriorly with dark fuscous on costa and inner margin; hind-marginal area dark fuscous; subterminal very obscure, fuscous-whitish, touching second line in middle, above this shortly interrupted; a series of obscure blackish marks on hind margin; cilia whitish, with faintly indicated darker bars, and an interrupted grey line. Hind wings 1½; fuscous-whitish, apex and upper half of hind margin slightly darker; a faint pale post-median line; cilia whitish, with a grey line, in male partially obsolete.

Three specimens.

38. *Xeroscopa pachysema*, n. s.

♀, 18 mm. Head white. Palpi three, black, apex and base white. Antennæ grey. Thorax black, slightly irrorated with white, with a white longitudinal streak on each side of back meeting behind. Abdomen pale grey. Legs black, ringed with white, posterior tibiæ white. Fore wings elongate, narrow, gradually dilated, costa hardly arched, apex obtuse, hind margin nearly straight, oblique, rounded beneath; ochreous-white, coarsely irrorated with black except in disc; first line thick, straight, ochreous-white, well-defined, strongly margined with black on both sides; orbicular and claviform confluent to form a large round black spot, touching black margin of first line; reniform sub-ovate, black, resting on costa above and second line beneath, connected with orbicular in middle, containing a white dot near lower extremity; second line ochreous-white, anteriorly strongly margined with black except shortly below reniform; hind-marginal area black; subterminal represented by an ochreous-white streak from middle of second line almost to hind margin above anal angle, and a short inwardly-oblique ochreous-white mark from anal angle; an irregular white hind-marginal line; cilia white, with an interrupted blackish line near base, and three or four grey quadrate posterior spots round apex. Hind wings 1⅓; pale whitish-grey, thinly scaled, posteriorly somewhat darker; a faint grey post-median line, followed by a whitish mark below middle;

hind margin suffused with darker grey; cilia whitish, with a grey line.

One specimen.

39. *Xeroscopa mesoleuca*, n. s.

♂, 14 mm. Head ochreous-white. Palpi 2¼, black, apex and base white. Antennæ blackish, ciliations two-thirds. Thorax ochreous-white, shoulders and an angulated forwards-pointing mark behind middle black. (Abdomen broken.) Legs black ringed with white, middle tibiæ with broad white subapical band, posterior tibiæ white. Fore wings very elongate-triangular, costa hardly arched, apex obtuse, hind margin nearly straight, rather oblique, rounded beneath; ochreous-white, yellowish-tinged; basal area wholly black except an ochreous-white basal dot; first line ochreous-white, interrupted with black in middle, anteriorly irregularly margined by the black basal area, posteriorly slenderly black-margined; orbicular and claviform confluent to form a transverse suboblong black blotch, confluent throughout with margin of first line, and extending from costa two-thirds across wing; costal edge towards middle sprinkled with black, dorsal edge narrowly black from first to second lines; reniform transverse-oblong, black, resting on costa above and second line beneath; second line slender, ochreous-white, black-margined, obsolete except on costal third and inner margin, hind-marginal area wholly black, anterior edge of reniform coalescing with it to form a straight line perpendicular to costa; subterminal irregular, ochreous-white, interrupted in middle, upper part touching costal portion of second line; some indistinct whitish dots along hind margin; cilia clear ochreous-white, on costa and below anal angle dark grey. Hind wings 1½; light grey, hind-marginal edge suffusedly darker; cilia whitish.

One specimen.

40. *Xeroscopa formosa*, Butl.

Scoparia formosa, Butl., Ann. Mag. Nat. Hist., 1881, 331.

♂, 17 mm. Head white. Maxillary palpi black, apex broadly white (labial palpi broken). Antennæ blackish, ciliations one-half. Thorax white, shoulders spotted with black. (Abdomen broken.) Legs black, ringed with white, posterior pair white, base of tarsal joints black. Fore wings elongate, narrow, gradually dilated, costa slightly arched, apex obtuse, hind margin nearly straight,

oblique, rounded beneath; white, slightly ochreous-tinged; a moderate black oblique basal fascia, its outer edge acutely tridentate (in middle and on both margins); outer edge of first line indicated by a straight black line; orbicular and claviform confluent into an irregular pentagonal black spot, anteriorly wholly confluent with margin of first line, posterior angle shortly produced to coalesce with reniform; reniform transverse-oblong, black, resting on costa above, lower angles shortly acutely produced; posterior edge of second line indicated by sharply marked edge of black hind-marginal area, anterior edge only by black dots on costa and inner margin; subterminal irregular, rather thick, ochreous-white, interrupted above middle, lower half touching middle of edge of second line; cilia clear white, slightly ochreous-tinged. Hind wings $1\frac{1}{2}$; pale grey, hind-marginal edge suffusedly darker; cilia grey-whitish, with a light grey line.

One specimen.

41. *Xeroscopa jucunda*, Butl.

Scoparia jucunda, Butl., Ann. Mag. Nat. Hist., 1881, 331.

♀, 16 mm. Head white. Palpi $2\frac{1}{2}$, dark fuscous, upper edge and base white. Antennæ dark fuscous annulated with white. Thorax white. Abdomen light grey, segmental margins white. Legs blackish, ringed with white, posterior pair white, base of tarsal joints black. Fore wings very elongate-triangular, costa slightly arched, apex obtuse, hind margin obliquely rounded; white, very slightly ochreous-tinged; a narrow irregular oblique black fascia near base, its outer edge acutely bidentate (above and below middle); outer edge of first line indicated by a black subdentate line; orbicular and claviform confluent to form a small 8-shaped black spot, its upper half connected by a projection with first line; reniform narrow, transverse, black, resting on costa above, its lower angles shortly acutely produced; posterior edge of second line indicated by sharply marked waved edge of black hind-marginal area, anterior edge only by black dots on costa and inner margin; subterminal very thick on lower half, thinner above, ochreous-white, entire, broadly confluent with edge of second line in middle; cilia clear white. Hind wings $1\frac{1}{2}$; whitish-grey, hind margin suffused with darker grey; a partially indicated whitish post-median line; cilia whitish, with a grey line.

Two specimens.

PTEROPHORIDÆ.

14. Trichoptilus, *Wlsm.*

42. *Trichoptilus hawaiensis*, Butl.

Aciptilia hawaiensis, Butl., Ann. Mag. Nat. Hist , 1881, 408.

♂ ♀, 14—16 mm. Head and thorax ochreous. Palpi brownish-ochreous mixed with whitish, second joint reaching middle of face. Antennæ ochreous-whitish, with a dark fuscous line on back. Abdomen ochreous mixed with ochreous-whitish, apex in male with a single moderate obliquely ascending hair-pencil. Legs white, longitudinally striped with blackish, posterior tibiæ banded in middle and at apex with dark ochreous-fuscous. Fore wings cleft from middle, segments linear; veins 2 and 10 present; brownish-ochreous, first segment more or less suffused with fuscous; an obscure dark fuscous dot in disc at one-third, and another on first segment at base; some white scales indicating very obscure bands on both segments before middle and towards apex; cilia ochreous-brown, on costa spotted with white on bands, on lower margin of first segment with two or three white scales on bands and a white subapical spot followed by a small black scale-tooth, on upper margin of second segment with a small white spot before apex, on lower margin of second segment with white bars opposite bands, interspaces greyer, and with a small black almost apical scale-tooth. Hind wings cleft firstly from one-fourth, secondly from base, segments linear; rather dark fuscous; cilia light ochreous-fuscous, third segment with a small well-defined black scale-tooth on inner margin at three-fifths, and a fringe of white hair-scales between this and base.

Six specimens. Closely allied to *T. centetes* and its group.

15. Platyptilia, *Hb.*

1. Palpi very long	.. ..	43. *rhynchophora*
,, moderate	.. ..	2.
2. Fore wings with two dark fuscous dots before middle		45. *brachymorpha.*
,, without ,, ,, ,,		44. *cosmodactyla.*

43. *Platyptilia rhynchophora*, n. s.

Platyptilia repletalis Butl., Ann. Mag. Nat. Hist., 1881, 407 (nec. Walk.).

♂ ♀, 17—18 mm. Head and thorax rather dark fuscous, finely sprinkled with ochreous-whitish; frontal cone short. Palpi very

long (four), rather dark fuscous, sprinkled with whitish above. Antennæ dark fuscous. Abdomen fuscous. Legs fuscous, beneath whitish, banded with dark fuscous, tibiæ not incrassated. Fore wings cleft from two-thirds, segments moderate, parallel-sided; fuscous, towards middle of disc and on costal and dorsal edges irrorated with blackish; an obscure cloudy dark fuscous dot in disc at one-fourth, and a second below costa at one-third; a cloudy blackish dot immediately before cleft, indistinctly extended to costa, where it is followed by some whitish scales; an indistinct dark fuscous bar extending across middle of both segments parallel to hind margin, anteriorly suffused, posteriorly margined by an obscure whitish line; cilia fuscous, slightly mixed with whitish, on hind margin with an obscure darker fuscous line, on inner margin with a few scattered black scales. Hind wings cleft firstly from middle, secondly from three-fourths, first and second segments moderately dilated; rather dark fuscous; cilia fuscous; third segment with a row of black scales on inner margin from base to middle, and one or two at three-fourths.

Three specimens. Immediately recognisable by the unusually long palpi.

44. *Platyptilia cosmodactyla*, Hb.

Amblyptilia cosmodactyla, Butl., Ann. Mag. Nat. Hist., 1881, 407.

Three specimens, darker and greyer than usual, but apparently identical. This species, ranging over Europe, South Africa, and North America, is probably transported through the agency of man.

45. *Platyptilia brachymorpha*, n. s.

♂ (?), 14 mm. Head and thorax light brown, thorax posteriorly ochreous-whitish. Palpi moderate (two), ochreous-brown, base and a median ring of second joint white, terminal joint mixed with white. Antennæ fuscous. (Abdomen broken.) Legs rather dark fuscous above, white beneath, tibiæ not incrassated. Fore wings cleft from two-thirds, segments moderate, parallel-sided; light ochreous-brown, irrorated with white; costa rather dark fuscous, dotted with white; a rather large dark fuscous dot in disc before one-third, and another beneath costa before middle; a triangular dark fuscous blotch on costa about two-thirds, reaching half across wing, terminating in two transversely placed black dots before cleft, followed by an obscure whitish suffusion; a white line

crossing both segments near hind margin, preceded in first segment by a large elongate black dot, in second by a small one, on costal margin of both segments by a dark fuscous suffusion, hind-marginal area beyond this fuscous; cilia of both segments on hind margin rather dark fuscous, slightly mixed with white, with a small black scale-tooth at lower angle, on inner margin fuscous-whitish with a few scattered very small black scales. Hind wings cleft firstly from middle, secondly from before three-fourths; first segment moderately dilated, spatulate, second slightly dilated, its apex very long-pointed, its hind margin very oblique and concave; rather dark fuscous; cilia fuscous, third segment with a row of black scales on inner margin from base to middle, and one or two at four-fifths.

One specimen.

46. *Platyptilia littoralis*, Butl.

Platyptilus littoralis, Butl., Trans. Ent. Soc. Lond., 1882, 44.

I have not seen the type of this species (I presume I overlooked it in the Museum), and Mr. Blackburn has sent no specimen under this name (in the case of all other described species he has labelled a specimen corresponding with the type forwarded to Mr. Butler); I am therefore unable to add anything on the subject of this species, but, if the description is correct, it should be distinct.

CRAMBIDÆ.

Hind wings with veins 6 and 7 stalked	16. EROMENE.
" " " remote	17. HEDNOTA.

16. EROMENE, *Hb.*

47. *Eromene ocellea*, Hw.

Eromene bella, Butl., Trans. Ent. Soc. Lond., 1882, 42 (nec Hb.).

I have elsewhere recorded my opinion that this species (now ranging very widely) is artificially introduced; probably, as suggested, in the packing-material of grocery-cases from the South of Europe.

17. Hednota, *Meyr.*

1. Hind wings with veins 4 and 5 stalked ..	..	48. *floricolans.*
„ „ „ not stalked ..	..	2.
2. Fore wings with apex almost acute	..	50. *oxyptera.*
„ „ tolerably rectangular	..	49. *hydrophila.*

48. *Hednota floricolans*, Butl.

Gesneria floricolens (rect. *floricolans*), Butl., Ent. Mo. Mag., xix., 180.

♂, 12 mm. Head and thorax grey sprinkled with ochreous-whitish, forehead obtusely prominent. Palpi 2½, pale greyish-ochreous mixed with grey. Antennæ dark fuscous, subserrate, ciliations two-thirds. Abdomen pale whitish-ochreous, sometimes sprinkled with grey. Legs dark fuscous, ringed with whitish-ochreous, posterior tibiæ suffused with whitish-ochreous. Fore wings elongate-triangular, costa gently arched, apex tolerably rectangular, hind margin almost straight, faintly sinuate, oblique; very pale greyish-ochreous or whitish-ochreous, more or less irrorated with grey, and with a few scattered black scales; three cloudy blackish dots in a curved transverse series near base; first line ochreous-whitish, posteriorly irregularly blackish-margined, from two-fifths of costa to two-fifths of inner margin, upper half moderately curved outwards, lower half slightly curved inwards; two blackish dots transversely placed in disc beyond middle; a small blackish suffused spot on costa beyond middle; second line from four-fifths of costa to four-fifths of inner margin, slender, blackish, on lower half almost obsolete, curved outwards, indented beneath costa, where it is preceded by an ochreous-whitish dot; an ochreous-whitish dot on costa before apex; cilia ochreous-whitish, with a slender interrupted blackish median line, basal half obscurely barred with a grey irroration. Hind wings with veins 4 and 5 stalked; whitish-fuscous, paler towards base; cilia fuscous-whitish, with a fuscous line.

Three specimens.

49. *Hednota hydrophila*, Butl.

Scotomera hydrophila, Butl., Trans. Ent. Soc. Lond., 1882, 36.

♀, 14 mm. Head, palpi, and thorax ochreous-fuscous; forehead obtusely prominent; palpi three, sprinkled with darker fuscous. Antennæ fuscous. (Abdomen broken.) Legs dark fuscous, ringed

with whitish-ochreous, posterior tibiæ pale whitish-ochreous. Fore wings triangular, somewhat elongate, costa slightly arched, apex tolerably rectangular, hind margin hardly rounded, oblique; ochreous-fuscous; lines cloudy, dark ochreous-fuscous, terminating in obscure blackish dots, first from before middle of costa to before middle of inner margin, upper half moderately curved outwards, lower half slightly curved inwards, second from three-fourths of costa to three-fourths of inner margin, upper two-thirds strongly curved outwards; two dark fuscous dots transversely placed in disc beyond middle, and a dark fuscous dot on costa beyond middle; a cloudy interrupted dark fuscous hind-marginal line; cilia light brownish-ochreous, with a cloudy dark fuscous line, basal half obscurely barred with darker. Hind wings with veins 4 and 5 from a point; light fuscous, paler towards base; cilia fuscous-whitish, with a grey line.

Two specimens.

50. *Hednota oxyptera*, n. s.

♂ ♀, 10 mm. Head and thorax whitish-ochreous, forehead obtusely prominent. Palpi four, ochreous-whitish, irrorated on sides with dark fuscous. Antennæ fuscous, in male filiform, ciliations two-thirds. Abdomen pale whitish-ochreous. Legs pale whitish-ochreous, base of tarsal joints dark fuscous. Fore wings elongate-triangular, costa slightly arched, apex almost acute, hind margin straight, rather strongly oblique; whitish-ochreous, sprinkled with brownish-ochreous, and more or less with fuscous; a small black dot in disc before first line, and sometimes another below it; lines light brownish-ochreous, indistinct, first from two-fifths of costa to two-fifths of inner margin, upper half curved outwards, second from four-fifths of costa to four-fifths of inner margin, upper two-thirds gently curved outwards; a distinct black dot on posterior margin of first line below middle, and sometimes a smaller one above middle; two small black dots obliquely transversely placed in disc beyond middle; a fainter subterminal line indicated near and parallel to second; cilia ochreous-whitish, with a fuscous line interrupted into dots, marked with three black dots at middle of hind margin, three-fourths, and anal angle. Hind wings with veins 4 and 5 almost from a point; whitish-grey, paler towards base, greyer posteriorly; cilia grey-whitish.

Four specimens. It is remarkable that Mr. Blackburn seems to have overlooked this species altogether, probably confusing it with the other two, as his collection

contained no specimens of it; I found it common in dry grassy places near Honolulu in August, but the specimens were all in rather poor condition. It is easily recognised by the different shape and pale colouring of the fore wings, the dots in hind-marginal cilia, longer palpi, and peculiar neuration of hind wings. In the latter veins 4 and 5 are strictly separate, but very closely approximated at origin; they are therefore in some sense intermediate between *Hednota*, in which they should be from a point or stalked, and *Diptychophora*, in which they are distinctly remote and more or less parallel. The specific relationship with the two preceding species, which are undoubtedly referable to *Hednota*, is so strong that I have no doubt as to where to draw the line; but the species probably points directly to the common ancestral origin of the two genera.

PHYCITIDÆ.

1. Hind wings with vein 8 free	..	20. Genophantis.
" " anastomosing with 7	..	2.
2. Antennæ in male with notch above basal joint	..	19. Homœosoma.
" " without " "	..	18. Ephestia.

18. Ephestia, *Gn.*

51. *Ephestia interpunctella*, Hb.

Plodia interpunctalis, Butl., Ent. Mo. Mag., xv., 273.

Two specimens. Artificially introduced; the favourite food of the larva is Indian corn (maize), with which it is probably imported.

52. *Ephestia desuetella*, Walk.

Three specimens. Introduced with grocery, and now cosmopolitan.

53. *Ephestia elutella*, Hb.

One specimen. Imported in the same way as the preceding species, but usually less common.

19. Homœosoma, *Curt.*

54. *Homœosoma humeralis*, Butl.

Ephestia humeralis, Butl., Ann. Mag. Nat. Hist., 1881, 332; *E. albosparsa*, ibid., 333.

♂ ♀, 15—20 mm. Head and thorax fuscous-grey, sprinkled

with whitish. Palpi dark grey, sprinkled with white towards base. Antennæ grey, ciliations in male two-thirds. Abdomen whitish-grey. Legs dark grey, middle and posterior tibiæ suffused with white. Fore wings elongate, narrow, posteriorly gradually dilated, costa slightly arched, apex rounded, hind margin very obliquely rounded; vein 5 absent (coincident with 4), 9 absent (coincident with 8); ochreous-grey, slightly sprinkled with whitish; a moderate costal streak suffused with white from base to near apex, posteriorly attenuated; first line straight, rather thick, cloudy, darker grey, sometimes preceded by a few white scales, from one-fourth of costa to two-fifths of inner margin; a small cloudy darker grey discal spot at two-thirds; second line very indistinct or obsolete, straight, slender, grey, followed by a few whitish scales, from costa near before apex to four-fifths of inner margin; cilia ochreous-grey sprinkled with white. Hind wings with veins 3 and 4 approximated, 5 absent, 8 absent; whitish-grey, thinly scaled; a cloudy dark grey hind-marginal line; cilia whitish, with an indistinct grey line.

Five specimens. Closely allied and very similar superficially to an undescribed species from New Zealand, and also to the Australian *H. vagella*; it is best distinguished by the absence of vein 5 of the fore wings, which is present in both these species.

20. Genophantis, n. g.

Forehead with projection of scales. Ocelli present. Tongue well-developed. Antennæ three-fourths, in male —?. Labial palpi rather long, obliquely ascending, second joint thickened with dense tolerably appressed scales, terminal joint short. Maxillary palpi moderate, loosely scaled. Fore wings with veins 4 and 5 approximated, 7 absent, 8 and 9 stalked. Hind wings $1\frac{2}{3}$; vein 3 closely approximated to 4, 4 and 5 stalked, 6 and 7 stalked, 8 free, closely approximated to 7 from angle of cell to beyond middle, lower median strongly pectinated.

Although the male is unknown, the genus appears sufficiently distinct. The free vein 8 of hind wings separates it from all but the *Ancrastia* group; in this it most approaches *Crocydopora*, and it is not improbable that the antennæ of male will show similar characters (basal tuft and sinuation), but differs in the presence of vein 5 of the fore wings, and in the maxillary palpi.

55. *Genophantis iodora*, n. s.

♀, 24 mm. Head and thorax reddish-fuscous. Palpi pale greyish-ochreous, sprinkled with dark fuscous and reddish. Antennæ light greyish-ochreous. Abdomen greyish-ochreous. Legs greyish-ochreous, slightly reddish-tinged, obscurely banded with dark fuscous. Fore wings elongate, narrow, posteriorly gradually dilated, costa slightly arched, apex obtuse, hind margin nearly straight, rather oblique, rounded beneath; dull fuscous-reddish on costal half, ferruginous on dorsal half; costal area and all veins suffused with blackish, those on dorsal half mixed with whitish-ochreous; first line moderate, whitish-ochreous, darker-margined, indistinct towards costa, from one-fourth of costa to two-fifths of inner margin, nearly straight, with a slight outwards-projecting angle in middle; a transverse, rather inwardly oblique cloudy blackish discal spot beyond middle, almost merged in general suffusion, tending to be produced as a cloudy inwardly oblique streak towards inner margin; second line indistinct, rather thick, serrate, whitish-ochreous, darker-margined, from four-fifths of costa to four-fifths of inner margin, almost straight, slightly indented beneath costa; a cloudy interrupted hind-marginal blackish line; cilia very pale grey-reddish, with rows of ochreous-whitish points. Hind wings light ochreous-grey; cilia pale whitish-reddish, with a faint grey line.

One specimen.

GALLERIADÆ.

21. ACHRŒA, *Hb.*

56. *Achrœa grisella*, F.

Two specimens. Imported, like *Ephestia*, with grocery, the larva feeding on dried fruits, wax, &c.; now almost cosmopolitan.

X. *Experiments upon the colour-relation between the pupæ of* Pieris rapæ *and their immediate surroundings, by* GEORGE C. GRIFFITHS, F.E.S.; *described and summarised by* WILLIAM WHITE, F.E.S.

[Read March 7th, 1888.]

CONTENTS.

1. INTRODUCTION.—The experiments described in the following paper grew out of a series of observations upon *Pieris rapæ*, which had been carried on by my friend Mr. George C. Griffiths, at Cotham (Bristol), with the view of determining the constancy or variability of the yellow variety of this common species of butterfly produced from mignonette-fed larvæ. Another question, that of the colour-variation of the pupæ, had meanwhile been systematically attacked by Mr. Edward B. Poulton, who, after submitting a very large number of specimens of this and other lepidopterous genera to strong colour-tests, had drawn up and thoroughly discussed the results obtained in a paper read before the Royal Society in February of last year, and which has since been issued, with an admirable coloured plate, in the 'Philosophical Transactions' (vol. 178, 1887, B., pp. 311—441).

Having been informed by my friend Mr. Poulton of the results of his observations, I suggested to Mr. Griffiths that he might conduct analogous experiments upon the larvæ in his possession, so that the results of two independent observations might be compared. Mr. Griffiths acted upon this suggestion, and conducted the series of experiments here detailed.

Mr. Griffiths ultimately forwarded all his notes, together with the entire batch of pupæ obtained (between 80 and 90 in number), carefully separated and labelled according to the various experiments, requesting me to classify the results, and to draw what conclusion I could from them. Though I desired the treatment, as well as the experiments, to be Mr. Griffiths's own work, he was so decidedly unwilling to undertake it that it only remained for me to agree to his request, and deal with his material to the best of my ability, upon the lines laid down in Mr. Poulton's paper.

To this explanation of my position in the matter I can happily add that I have been greatly assisted by Mr. Poulton, who was so good as to assist Mr. Griffiths and myself in drawing up the primary classification of the pupæ, according to the colour-standards he had originated.

Notwithstanding the subsequent assistance given by Mr. Poulton, the experiments themselves were, of course, entirely independent, and the conditions were somewhat varied; but Mr. Griffiths agrees with me in feeling confident that the results are brought into a perfectly true and safe comparison with those obtained by Mr. Poulton in his original experiments.

It is unnecessary to refer here to the literature of the subject, for an account of earlier observations is given in Mr. Poulton's previously-quoted paper. There is, however, a remark of Prof. Meldola's, which is so important that I must quote it at length. The following words were used by Prof. Meldola on the occasion of the reading of a paper by Mrs. Barber in 1874 before this Society[1] :—"The action of light upon the sensitive skin of a pupa," he said, "had no analogy with its action on

[1] This paper, which was communicated by Mr. Darwin, bore chiefly upon the pupa of *Papilio nireus* of Cape Colony (Trans. Ent. Soc. Lond., 1874, p. 519).

any known photographic chemical. No known substance retained permanently the colour reflected on it by adjacent objects."* Such a statement leads us to infer that the varying colours of pupæ are *not* directly due to any influence of an external photographic nature, as had previously been asserted by Mr. T. W. Wood,† but rather emanate from within the organism itself upon the incidence of the appropriate stimulus, as Mr. Poulton has suggested.

With regard to the question of consciousness of the process on the part of the insect, Mr. Poulton concludes that the production of appropriate results is probably automatic, and altogether beyond the control of the insect.

The experiments made by Mr. E. B. Poulton included a vast number upon the pupæ of the *Vanessidæ*, in which case the very remarkable effect upon those which were exposed to gilded surroundings constitutes the most striking result in the artificial production of a character that has ever been attained, the pupæ often appearing as if they had been covered with gold leaf. Although the results obtained in this family are very different from those caused in the genus *Pieris*, the physiological nature of the susceptibility must be in many respects the same. Green, on the other hand, which is so important a factor in the *Pieridæ*, produced absolutely no effect.‡ But, although Mr. Poulton shows that the *Vanessidæ* are affected differently by different colours, there are tints which do not produce any constant effect, or produce an effect which is not protective; and the same colours often produce very different effects upon pupæ of different genera. Thus *orange*, which had no effect upon *Vanessa*, exercised the peculiarity of producing a more intense *emerald-green* colour in the pupæ of *Pieris* than was produced by even *green* itself;

* Proc. Ent. Soc. Lond., 1874, p. xxiv. See also Prof. Meldola's paper, communicated to the Zoological Society the previous year, "On a certain Class of Variable Protective Colouring in Insects" (Proc. Zool. Soc., 1873, p. 153); also his important annotated translation of Prof. Weismann's 'Studien zur Descendenz-Theorie' (Leipzig, 1875), Part II., 1881, which contains many records bearing upon the general subject.

† Proc. Ent. Soc. Lond., 1867, pp. xcix—ci.

‡ Ibid., pp. 394, 395.

whilst *blue* does not influence the *Pieridæ* in any way, the pupæ being simply normal.

Before proceeding further it will be well to explain what we mean by the term "normal" in its strict sense. Mr. Poulton has applied it to express the results of a tendency "which manifests itself when tho larva is placed among colours to the influence of which it is not sensitive"; and he further states, "the resulting pupæ deserve the name 'normal' for another reason—because they are generally the commonest forms met with." The former fact is doubtless explained by the latter, for the "commonest" pupæ are those which have been most frequently selected as best adapted to the commonest form of surroundings, and this process of selection, being repeated generation after generation, will gradually form for the larvæ "*a line of least resistance*, along which the pupal colours will always tend to travel, not only when the appropriate stimulus is present, but also in the absence of any colour which can act as a stimulus to the larva."*

Preliminary condition of the larvæ before and after capture.—The series of larvæ of *Pieris rapæ* under consideration were all, with but one exception, found upon mignonette-plants, specially sown by Mr. Griffiths for the experiments in his garden. The larvæ occurred upon seven or eight different clusters of plants; and, as they varied greatly in size, and in the datos of their capture, it is quite clear that we are concerned with more than one brood. Thus more than one, and probably many, hereditary influences must have been at work. The larvæ were transferred to a breeding-cage kept in an outhouse, and were watched daily by Mr. Griffiths, being fed upon mignonotte up to maturity. As they matured and exhibited by their restlessness and other premonitory signs that pupation would shortly take place,—in other words, whilst they were in the transitional period designated by Mr. Poulton "Stage I." of the "preparatory period,"†—they were removed from the cage, and placed singly, or, in some instances, two individuals together (at the most), in separate receptacles, generally glazed white jars. The entire number of specimens captured was 86; of these 13 died

* *Loc. cit.*, p. 393. † *L. c.*, pp. 327, 328.

or suffered accident; 5 died during the pupal ecdysis, but only one was attacked by parasites;* 2 were disqualified for other reasons: thus 74 form the data upon which this paper is written.

2. THE METHODS OF EXPERIMENTATION.—Such individuals as were to be submitted to the influence of a single predominating colour were surrounded by the particular tint in the following manner:—The internal surface of the jar was first completely lined with tissue-paper of a selected colour, placed loosely (to allow of easy removal); the larva was then placed in it, *together with a mignonette-leaf or two* in every instance, a point which it is necessary to bear in mind; a square piece of the same paper, bearing the diary number of experiment, was next laid over the mouth of the jar, to complete the environment, and this was covered by a piece of clear glass to secure it and to admit a sufficient amount of light.

The colours employed in the single-colour experiments were *Black*, *Pink*, *Yellow*, *Green*, and *Blue*. Tinfoil was also tried in two cases, but without producing any noteworthy results (only the average grey colour typical of "normal" specimens), and hence these are not included in our classification.

Most of the larvæ remained subjected to the various imposed influences for a period which covered several days; that is to say, throughout the "Stages II. and III." of Mr. Poulton (see below). Unfortunately, however, Mr. Griffiths did not take any notes as to the length of the periods during which the different larvæ were respectively influenced. Mr. Poulton found it convenient to consider the period preparatory to pupation as consisting of the three following "stages":—

"*Stage I.*, in which the larva quits its food-plant" in search of a suitable situation for pupation.

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* Since writing the above a dipterous parasite emerged from another specimen on January 31st, whilst no less than seventeen have emerged since the reading of the paper, nearly all at the time when the imagines would have matured. There was no evidence whatever of the presence of parasites, and that they had no influence in relation to the colour is clear from the fact that they occurred indiscriminately upon all grades of colour. In every case only one parasite was produced from each insect attacked.

"*Stage II.*, in which the larva rests motionless upon the selected surface, and towards the end of the stage spins the boss of silk for its subsequent suspension" (*Vanessa*). The only variation in the case of *Pieris* being that it proceeds to spin first a slight *web* for attachment, and then adds the silken *anal support and girdle* whilst in this stage.

"*Stage III.*, in which the larva (*Vanessa*) hangs suspended by its posterior claspers from a boss of silk;" or in *Pieris*, in which it remains girdled in a passive state until the ecdysis takes place, and it becomes a pupa.*

With regard to the duration of these stages in *Vanessa urticæ*, Mr. Poulton found that Stage I. is variable, depending upon the relative proximity of surfaces suitable for pupation; Stage II. lasts for about 15 hours; and Stage III. about 18 hours. The larvæ are sensitive to surrounding colours for about 20 hours preceding the last 12 hours of the whole period.

In regard to these stages, the conclusions arrived at by Mr. Poulton, after many elaborate and extensive observations on the point, is that "Stage II. is the time of chief susceptibility to surrounding influences," and that "the larva can hardly be susceptible after the first part of Stage III."†

Although Mr. Griffiths was unaware of the special interest attaching to the period before pupation, and therefore neglected to take any notes, the general conclusions contained in Mr. Poulton's statement, which I have just quoted in abstract, are fully borne out by Mr. Griffiths' results, which are indeed incapable of any explanation otherwise. It is, therefore, much to be

* *Loc. cit.*, pp. 327, 328.

† Ibid., p. 340. On p. 360 Mr. Poulton further observes, respecting Stage III., that, "although this stage is, as a rule, so much longer than any other, the larval sensory surfaces are probably only in a condition to be influenced in its most early part, for very rapid changes of pupal construction and shape are going on beneath the surface. These would seem to preclude the possibility of an external shell, shortly to be cast off, having any important physiological relation with the organism beneath. But in Stage II. the larva retains its shape, and the whole of its surface is in close relation with the colour into correspondence with which the pupal tints will afterwards deepen." See also p. 392 of Mr. Poulton's paper.

hoped that future investigators will remember that *the early part of Stage III.* is the time which most of all requires defining in various species; for it may be assumed that Stage II. is the chief time of susceptibility in all species.

It will be seen that the larvæ attached themselves, in nearly every instance, to the coloured-paper linings, in preference to pupating upon the mignonette leaf in the jar. A single larva, however, which was surrounded by tinfoil, fixed itself to the leaf, but subsequently died. It appears at first singular that the larvæ should have so generally avoided the leaf of their food-plant, but a probable explanation may, I think, be found in the fact that the pupæ hybernate, whilst nearly all their food-plants are annuals, or die down in the winter.

Conflicting colour experiments were also attempted; but as Mr. Griffiths added the second colour, and in many cases both colours, after the beginning of Stage III., it is quite clear that no real test was imposed. Those cases in which one colour was allowed to act during the whole period before pupation, and a second added later beneath part of the body at a probably non-susceptible time, may be considered as practically single-colour experiments. The conflicting colours were the same as those made use of in the single-colour experiments, with the addition of *red* and *gold*.

3. The Nature of the Colours employed.—The coloured tissue-paper made use of was in some respects unfortunate, the paper in most cases being so transparent as to admit much white light, greatly diminishing the colour-influence. On the other hand, the adoption of colours, somewhat different from those used by Mr. Poulton, has proved to be the reverse of detrimental to the experiments, since a fuller opportunity of comparing the results of near tints has been afforded. The results, as will be seen, are equally satisfactory with those of Mr. Poulton, and are entirely confirmatory of those obtained by him with stronger and generally opaque colours employed as a back-ground for the pupæ. Further, the adoption of so much paler tints has even proved a distinct advantage, in that we can more fully

realise how surprisingly sensitive the pupæ of this species are to surrounding influences.

On the occasion of my taking the materials to Mr. Poulton, he was good enough to make a spectroscopic examination of the coloured papers employed, using a Zeiss's microspectroscope, with an Abbé's illuminator; but although the conditions of illumination were very favourable, the results cannot, unfortunately, be expressed satisfactorily in the scale of wave lengths, because of the large amount of white light which passed through the thin tissue-paper, or was reflected from its surface. It was clear, however, that the colour of the paper predominated in the spectrum, all other colours being *relatively* absorbed.

4. Mr. Poulton's Standard of the Degrees of Colour in the Pupæ of P. rapæ.*—For the purpose of classifying the various degrees of colour assumed by the pupæ of *Pieris rapæ* resulting from his experiments, Mr. Poulton established a code of grades, five in number, which are given in full below, with their characteristic features. The colours of eleven of the chief varieties produced by him are beautifully figured in the plate accompanying his paper.

"(1). The darkest forms plentifully dusted with minute black dots, producing a very dark grey appearance. There is very much pigment on the wings, and black patches are especially developed on the dorsal and sub-dorsal ridges or lines, and upon the rostrum. The ground colour is hardly recognisable apart from the grey dusting, but can be seen clearly in certain parts of some pupæ, and is then usually of a faint pinkish or dull yellowish tint, or some mixture of these colours.

(2). Much less dark, due to the reduction in the amount of the minute dots and the black patches, which occur in the positions described above. Nevertheless, these pupæ are, as a rule, of darkish grey appearance. The ground colour is often more clearly recognisable, and is generally of the same tints as above, but the differences between the various tints are not generally well-marked until (4) is reached.

* Phil. Trans. (&c.), pp. 410, 411.

(3). Still lighter, but with sufficient of the grey dusting to obscure the tint of the ground colour and to produce a grey or light grey appearance. The black patches still occur in the same positions, but they are smaller; the same ground colours were recognisable.

(4). Very light, with little or almost none of the grey dusting, so that the ground colour is predominant in producing the general appearance. The black spots and patches are very slightly developed and sometimes entirely absent, except for a few black points on the side of the rostrum, which is the last position in which traces of the pigment patches are retained. It is, however, common to find a slight, but distinct, speckling due to minute black points, but not sufficiently numerous to combine with the lighter ground tint and produce a grey result. The ground colours are much more distinct, as they are not dimmed, and are generally pinkish, yellowish, or faint greenish, or some combination of these. The latter colour is transitional into the brighter tints of the next degree.

(5). In certain pupæ the green ground colour is sufficiently distinct to warrant their classification as a separate degree. All varieties of colour are met with, from the faint, scarcely perceptible, yellowish green tinge of certain pupæ in the last degree to the more distinct and bright yellow greens arranged under this head, and finally up to a magnificent transparent emerald-green, which forms the culmination of the development of this tint as a ground colour. There are also dull greens, and sometimes these pupæ are dusted with grey spots and have the black markings developed to a considerable extent (such a pupa is figured plate 26, fig. 31, natural size), but, as a rule, these pupæ are the lightest of all in both these respects. The lens, however, shows the existence of minute dots in all cases, although in the more extreme forms very few minute points can be detected by the naked eye, and there is no trace of the black markings even upon the rostrum. It is very common in the extreme forms of this degree, and in the lightest of the last degree, for the median and lateral ridges and the extremities of the body to be of a distinct pink tinge."

5. Experiments with various Colours :—

I. Black.

A. In these experiments the paper used was opaque, and, in addition to the complete lining of the jars with the black paper, the square pieces of glass surmounting them were previously densely smoked on the side placed uppermost.

Data.—Eight larvæ, all of which pupated Sept. 3rd to 15th. In one case the lamp-black was accidentally rubbed off from a small area (by a finger-touch), and the contained larva selected this particular spot for pupation. This case does not therefore properly belong to this series, but it is interesting to retain it for the sake of comparison.

Results.—

2 pupæ were	dark (1),	1 typical and pinkish, while the other had been accidentally injured.
2 ,, ,,	(1),	1 typical and yellowish, while the other had also been injured.
3 ,, ,,	(2),	1 distinctly pinkish, the others faintly so.
1 ,, ,,	light (3),	being the pupa upon the clear area on the blackened glass.
—		
8		

B. An additional pupa, which was found on "*tarred stones* on the top of a wall at Clevedon (Somerset)," on October 3rd, must also be included here. When finally examined it was dead, but from its appearance it could safely be classed as a (1) yellowish, and Mr. Griffiths' description of it when alive is as follows :—"Very dark grey; spots profuse, black angles and wing-cases; median line greyish, much interrupted by spots." This occurrence is an interesting one, as it affords an instance, as Mr. Griffiths remarked, of a larva voluntarily selecting the black surface to pupate upon, after crawling over the lighter-coloured untarred stones of the wall.

These results confirm those obtained by Mr. Poulton by the use of black surroundings, except that there is here no evidence of the illumination producing any effect. There was also another point in Mr. Poulton's paper which was confirmed by these results. Mr. Poulton had found that darkness had the effect of prolonging the period before pupation, and remarks, in his paper, that*

* Page 482.

"possibly this increased length of time may bear upon the formation of pigment; or, conversely, that a shortened period may be brought about by certain reflected colours, and that the absence of pigment may ensue as a secondary result. This suggestion," he continues, "appears to be worth a careful trial, and, even if it does not contribute to the elucidation of this most difficult question, the protracted period in darkness may be useful to the organism in another way,—to give it the opportunity of being affected by surrounding colours after change in the conditions of illumination. Thus, if the most sensitive part of the period were passed during the night, it would be to the advantage of the species for such a susceptible condition to be prolonged as far as possible." In the experiments with black Mr. Griffiths adds corroborating testimony to this, which he gives in the following words:—" The length of time they were retarded in changing under *black* surroundings was so noticeable as to attract my attention, though at the time I did not attach importance to it."

II. White.

Although this influence was not made use of in the regular single colour experiments of Mr. Griffiths, but was used for an attempted production of conflicting stimuli, it has already been pointed out that the results must be considered here, for the other tints were added towards the close of or after the susceptible period. The experiments were conducted as follows:—The larvæ were allowed to fasten themselves to the glazed white jar, and, as soon as the silken girdle and anal attachment were completed, a small slip of paper of one colour was gently inserted between the points of suspension, and a second slip of the other colour laid under the head and thorax to meet it, thus forming a marked opposition of colour influences. In other instances the larvæ were induced to attach themselves to tissue-paper, a slip of paper of another colour being afterwards inserted beneath the abdominal segments. Thus the larvæ were at no time exposed to the later stimuli for more than Stage III., and the susceptible part of it must have been entirely excluded in many cases.

Data. — Four larvæ, the details respecting which

require to be given separately. (*a*) attached itself to the side of the jar which was in shadow; a slip of opaque and strongly-coloured *Blue* paper was placed underneath the posterior *half* of the caterpillar's body, and a slip of gilt paper beneath the anterior thoracic half. (*b*) treated similarly, but had attached itself on the illuminated side of the jar, and the same colours were applied in reversed position. (*c*) had a slip of *Black* paper similarly placed below the thoracic half, and *Gold* under the abdomen. (*d*) had the anterior half over a background of a strong bright *Red* opaque colour, and the posterior half backed by *Green* (the same tissue-paper as was used in Series I.). During the pupal ecdysis the attachments gave way, and it fell to the bottom of the white jar.

Results.—

(*a*). The pupa was a typical (2), with a yellowish-pink ground colour.

(*b*). The pupa died, but it had been previously described by Mr. Griffiths in these words:—"Greenish-grey; abdomen light, median stripe with distinct spots; angles spotted, but not the area."

(*c*). The pupa was a typical (4), with a yellowish ground colour.

(*d*). The pupa was a typical dark (3), with a pinkish ground colour.

These results form but an imperfect test of the influence of white surroundings, and some of the effect was no doubt interfered with by the other colours, but the numbers are too few and the results too diverse to attempt to draw conclusions.

III. Pink.

A. Tissue-paper of a very pale colour, much liable to fade upon exposure to light, as indeed occurred in most of the experiments.

Data.—Sixteen mature larvæ were exposed to this influence, and all duly pupated between August 26th and September 15th.

Results.—

4 pupæ were dark (3), 3 being typical and pinkish (1 deformed), and 1 yellowish, with pigment patches strongly marked.

3 „ „ (3), 1 typical and pinkish; 1 greenish, with patches well-developed; 1 yellowish, with patches well-developed.

3 pupæ were	light (3),		2 typical and greenish, faintly coloured; 1 typical and yellowish, patches very slightly developed.
1 ,,	,,	dark (4),	typical and faintly pinkish.
4 ,,	,,	(4),	2 typical and pinkish; 1 faint and 1 distinct, 2 typical and faintly yellowish.
1 ,,	,,	light (4),	typical and faintly pinkish.
16			

The results contrast very strongly with those recorded by Mr. Poulton as produced by deep red, for the pupæ were very dark in tint, while these are on the whole very light. The explanation is no doubt due to the extreme paleness and transparency of the tissue-paper employed by Mr. Griffiths, so that the results approximate to those which might be expected from white paper, and, in fact, the spectrum of the former paper was barely distinguishable from that of white light. At first sight it may appear as if the pinkish ground tint of many of the pupæ may have been determined by the pink surroundings, but this is extremely improbable, because the pink shade of ground colour is always and in all grades of pupal colour (except (5)) by far the commonest, and it will be found to be equally predominant when other colours were employed.

B. Another experiment was intended as a test of the effects of conflicting colours, but it really belongs here for the reasons given above. In this experiment the larvæ were treated exactly in the manner described above under *Pink* until Stage III., when other colours were added, as described below.

Data.—Three larvæ, which must be described separately. (*a*), when girdled *Green* tissue-paper was inserted anteriorly, under about one-fourth of the body, the rest of the body remaining on the *Pink* paper. (*b*), *Blue* paper was similarly placed anteriorly, and gilt paper posteriorly, the colours occupying equal areas. (*c*), to the anterior half *Gold* paper was added, and *Black* posteriorly, about equally.

Results.—

(*a*) was a	dark (3),	typical and	yellowish.
(*b*) ,,	light (3),	,,	,,
(*c*) ,,	dark (4),	,,	pinkish.

These results harmonise completely with those described above, no effect being produced by the colours which

were added in Stage III. Hence we see strong confirmation for the susceptibility of the larvæ in the earlier stage, as found by Mr. Poulton.

IV. Yellow.

A. The tissue-paper was of a strong mustard-yellow colour.

Data.—Twelve larvæ employed, all of which pupated on various days between Sept. 2nd and 18th.

Results.—

1 pupa was	light (3),	yellowish and typical, but with, perhaps, an unusual absence of black pigment patches.
2 pupæ were	(4),	both typical and greenish.
3 „ „	pale (5),	2 very pale yellowish green, with black patches unusually developed; 1 similar, but somewhat deeper in colour, typical.
6 „ „	deep (5),	3 distinctly green, but not very bright, somewhat unusual black patches; 3 *bright* green; 1 with extremely little pigment.
12		

The production of green is here most striking. The colour is in the extremest cases a bright emerald-green, considerably stronger than the deepest green figured on Mr. Poulton's plate. The colour used by Mr. Poulton was of a lighter shade, but the results confirm each other in a most interesting manner, for Mr. Poulton also found that *Yellow* (and *Orange* also) produced far stronger effects in the direction of green than are caused by *Green* itself.

B. In this case also an attempted conflicting colour experiment is best included here, for the larvæ were treated as above described until Stage III.

Data.—Of nine larvæ (*a*), (*b*), (*c*), and (*d*) had *Black* paper introduced posteriorly in Stage III.; (*e*), (*f*), and (*g*) had *Black* introduced anteriorly; (*h*) had *Blue* added anteriorly; (*i*) had *Blue* added posteriorly.

Results.—

(*a*) was a deep (5), typical, the green exceedingly distinct and deep.

(*b*) „ „ (5), typical.

(*c*) „ pale (5), with well-marked patches.

(*d*) „ light (4), pinkish.

(*e*) „ pale (5), dead; but Mr. Griffiths had noted, "Bright green, yellow median line, and angles almost unspotted."

(*f*) was a pale (5), pinkish; almost entire absence of spots.
(*g*) „ light (4), yellowish.
(*h*) „ deep (5), lightish, with typical absence of pigment.
(*i*) „ „ (5), dead; but Mr. Griffiths had noted, "Green, almost unspotted; thorax dark; bright yellow median line."

The effects of yellow being so much more characteristic and pronounced than those of pink, it is more clear than ever that in these results the yellow surroundings have had their full influence unaffected by the colours which were added later. The strongly pronounced green tint of the pupæ, and the very marked absence of pigment, entirely agree with those described above, and with them confirm Mr. Poulton's results with yellow and orange in a most interesting manner.

V. Green.

A. The tissue-paper was of a *slightly* bluish-green colour when held up to strong daylight; otherwise a medium green colour.

Data.—Eight larvæ, which pupated between Sept. 2nd and 18th. One of these was attached to the glass covering, although almost surrounded by the green background.

Results.—

1 pupa was (3), greenish, the patches well-developed.
2 pupæ were light (3), both typical and pinkish.
1 pupa was dark (4), typical and greenish, very faint colour.
3 pupæ were (4), 1 typical and greenish; 2 typical and pinkish.
1 pupa was pale (5), typical.
—
8

B. In the case of two other larvæ the surroundings were constituted by the green of mignonette-leaves.

Data.—Two larvæ come under this head: of these one pupated on August 7th amongst mignonette-leaves, in a white jar covered with plain glass; the pupa, when found, was upon, and surrounded by, the leaves, and quite apart from the white surface of the jar, but without any silken attachment. The second larva pupated in an earthen jar, concealed amongst mignonette-leaves.

Results.—Both pupæ were deep (5), one being of a *bright* green colour, highly typical, with hardly any

pigment; while the other was, at the time of examination at Oxford, dead, and so could not be accurately described. It appeared, however, as if the black spots had been strongly pronounced and accompanied by an unusual "dusting." Mr. Griffiths and I had, however, examined it whilst it was alive, and the following description is given in Mr. Griffiths' note-book:— "Green; thorax and wing-cases dark; median yellow stripe strongly spotted."

C. Here also a conflicting colour experiment was attempted, but with only a single larva, which had been treated as described above until Stage III., when a strip of bright *Red* opaque paper was added posteriorly.

Result.—The pupa was dark (3), typical and yellowish. The red *may* have had some influence here, for the colour is darker than any produced by green alone either in these or in Mr. Poulton's experiments. On the other hand, the increased darkness is not extreme, and it is impossible to feel confidence in the results shown by a single pupa.

The results with green harmonise with Mr. Poulton's records.

VI. Blue.

A very pale and transparent blue tissue-paper was used.

Data.—Five larvæ, one of which was taken on cabbage (and the only one not fed upon mignonette); all pupated from Aug. 24th to Sept. 7th.

Results.—

1 pupa was (2), with a pinkish ground colour; the pupa was very black anteriorly and on the wings, but the pink ground colour very distinct and light, in patches anteriorly, and almost uniform posteriorly: hence classed as a (2), though it has the pigment of a (1) in parts, with the ground colour of a (3) or a (4) elsewhere. A very remarkable pupa.
3 pupæ were (4), 2 typical and pinkish; 1 typical and yellowish.
1 pupa was light (4), typical and pinkish.

5

As in Mr. Poulton's experiments (with a much darker shade of blue) no special effects seem to have been produced by these surroundings. It is, however, probable that the extreme paleness of the tint and consequent

predominance of white light may have assisted in the production of such light-coloured pupæ (with the exception of the first described).

Before proceeding to a few miscellaneous experiments made by Mr. Griffiths, it will be well to tabulate all the results recorded above, and to include for comparison the results Mr. Poulton obtained with *P. rapæ*, as shown in the table on p. 428 of his paper (*l. c.*). It must be remembered, however, that Mr. Poulton's results were confirmed by an almost equal number of experiments with *P. brassicæ*. The conditions of illumination were varied greatly in Mr. Poulton's experiments, but for a complete account of the methods, &c., the paper itself must be consulted. Owing to the method adopted by Mr. Griffiths, and previously described, the colours employed must have been always in shadow. Mr. Poulton used a somewhat similar method in the case of some of the experiments with green, but so arranged that the illumination remained moderately strong.

Two of Mr. Griffiths' pupæ have been omitted from the table, the one under I. A., which pupated on the clear area, and pupa (*b*) under II., because it could not be placed in any of the degrees of colour with certainty. This table brings out the very great uniformity which exists between these two independent sets of experiments, and the confirmation is most complete and striking just where the results are most marked, *viz.*, when yellow surroundings were employed. Mr. Poulton has shown the results of his experiments graphically (*l. c.*, p. 431) by a curve of which the ordinates represent the average amounts of pigment obtained in the several experiments, while the abscissa line is formed from the scale of wave-lengths. As it was impossible to obtain satisfactory spectra from Mr. Griffiths' pale tints and discontinuous tissue-paper, it was thought better not to construct a curve to express his results; but the ordinates were calculated by the use of Mr. Poulton's scale, and were found to correspond with the lengths of those of his scheme in a very remarkable way. But this fact is apparent by a simple inspection of the table given below, which in reality shows far more than could be seen by the graphic method.

Table showing the Results of all the Experiments described, and comparing them with those obtained by Mr. Poulton.

	Colours used as stimuli and number of experiment.	Degrees of Colour. Dark (1)	(1)	(2)	Dark (3)	(3)	Lgt. (3)	Dark (4)	(4)	Lgt. (4)	Pale (5)	Deep (5)		Observations and Conclusions.
E. B. Poulton.	Black surface in darkness					2	1			1			= 4	The greater darkness of the pupæ with the increasing illumination of the black surface is very remarkable and interesting.
	Black surface somewhat shaded		4	1		3	2						=10	
	Black surface less shaded	5	2										= 7	
	Black surface probably less shaded	5	6										=11	
G. C. Griffiths.	I. A. Black surface in darkness	2	2	3									= 7	Strongly confirm the effects of black, but not the curious relation to illumination.
	I. B. Black surface in strong light		1										= 1	
E. B. P.	White surface in very strong light						2	1	1	12	3		=19	The greater lightness of the pupæ with greater illumination is the converse of the results with black surfaces.
	White surface in strong light					1	2	2	5	1	1		=12	
	White surface almost in complete darkness ..			1						1			= 2	
G. C. G.	II. White surface with varying illumination, and obscured by other colours towards end of experiment			1	1				1				= 3	The effect may have been marred by other colours, but the numbers are too few to draw conclusions.
	III. A. Pale pink in shadow				4	3	3	1	4	1			=16	The results are probably due to the light paper tending to light pupæ, the faint shade of pink tending towards darker pupæ, but hardly strong enough to produce effect.
	III. B. Same, only other colours added in Stage III.				1		1	1					= 3	
E. B. P.	Red-brick walls, illumination probably variable	12	9						2				=23	The dark tendency of a pronounced red is well seen here.
	Orange (deep) in fairly strong light							1	2		2	1	= 6	This marked green effect (and absence of pigment) confirmed by *P. brassicæ.*
	Yellow (pale) in fairly strong light						1				1		= 2	As above, only not so strongly towards green. *P. brassicæ* also confirms.
G. C. G.	IV. A. Strong yellow in shadow..						1		2		3	6	=12	Confirms the two latter results conclusively. Clear proof that the colours added in Stage III. were without effect.
	IV. B. Same, only other colours added in Stage III.									2	3	4	= 9	
E. B. P.	Green (yellowish) in moderately strong light ..						3		2	3	1	1	=10	It is very remarkable and interesting that the green should tend less strongly towards green pupæ than yellow and orange, as shown above. Confirmation from *P. brassicæ.*
	Same, with green leaves											1	= 1	
	Pale bluish green in strong light					1	1			1			= 3	
	Deep green paint, somewhat shaded ..		1			1	1		3				= 6	
G. C. G.	V. A. Green in shadow ..					1	2	1	3		1		= 8	These results quite confirm those given above.
	V. B. Green of leaves in shadow											2	= 2	
	V. C. Same as A., only other colours added in Stage III.				1								= 1	
	Pale blue in shadow ..			1					3	1			= 5	The lightness of pupæ probably due to paleness of paper.
E.B.P.	Dark blue in strong light				1	2	2	1	1	1			= 8	Darker pupæ because of darker colour.

6. MISCELLANEOUS EXPERIMENTS.—A. *Conflicting colours.* —Two larvæ were accidentally treated so as to be exposed to conflicting colours for nearly the whole of the period before pupation. These larvæ, while wandering in Stage I., worked their way behind the tissue-paper and fixed themselves to the surface of the white jars, so that the ventral surface was exposed to white and the dorsal surface to the coloured tissue-paper.

Data.—One larva (*a*) was exposed dorsally to *Blue* tissue-paper; one larva (*b*) was exposed dorsally to *Pink* tissue-paper.

Results.—

(*a*) was (4), typical and pinkish.
(*b*) „ (4), typical and strongly pinkish.

It appears that these results were caused by the white surface, aided, or, at all events, not interfered with, by the pale colours. It is noteworthy that these pale tissue-papers seemed, in the experiments previously described, to produce light pupæ rather than those with darker pigment, such as might have been expected from the colours themselves.

B. *Attempted conflicting colours.* — A larva having entered Stage III. on the plain deal side of a glass-covered wooden box, *Red* was added anteriorly and *Green* posteriorly. During the pupal ecdysis the girdle was broken.

Result.—The pupa is described in Mr. Griffiths' notes as "pinkish at first, with a well-defined yellow stripe, but it faded to greyish green, with darker wing-covers." When examined with the others it was a (4) greenish and typical. It is probable that this pupa assumed its "normal" colour, perhaps slightly directed towards a light form by the colour of the deal surface.

C. Two larvæ pupated on clear glass jars (containing leaves of the food-plant).

Results.—

1 pupa on a smooth surface was (4) pinkish, typical.
1 pupa on a fluted surface was deep (5), very deep green.

Tin-foil was used as a stimulus in three cases, but the commonest grey pupæ were produced, and this environment was probably without effect upon them.

No very satisfactory conclusions can be drawn from these few miscellaneous experiments, the data being

insufficient. The light-coloured and green pupæ produced by the clear glass are interesting, and confirm the general result of Mr. Poulton's similarly-arranged experiment, showing that, on the whole, strong illumination and the proximity of green leaves does produce these appearances. The pupæ in experiment (A) show the effect of white surroundings.

7. CONCLUSIONS.—The general results of these experiments may be shortly summed up as follows:—

(*a*). Mr. Griffiths confirms Mr. Poulton's observation that dark surroundings exercise a retarding influence upon the period before pupation.

(*b*). In the failure of the attempted conflicting colour experiments (in which the colours added in Stage III. produced no effect), there is strong confirmation of the results of Mr. Poulton's experiments on *Pieris* and *Vanessa*, which show that the freshly-formed pupa is *not* photographically sensitive, and that Stage II. is the time of chief susceptibility. Compare especially the results of the two sets of experiments with yellow (IV. A. and IV. B) in support of this, although these are only more striking than others because the yellow is itself a much stronger influence.

(*c*). The general results of the colours themselves also entirely confirm Mr. Poulton's experiences. This is notably the case with the dark pupæ produced by black, the green pupæ produced by yellow, and the effects of green, and of white (as far as they go). The pale colours, pink and light blue, probably acted as somewhat dusky white surroundings, producing indeterminate, but, on the whole, rather light, results.

(*d*). The special effect of yellow surroundings in arresting the formation of dark superficial pigment, and in tending towards the production of green pupæ, were very striking, and confirm Mr. Poulton's suggestion that rays from this part of the spectrum, when predominant in the light incident upon the susceptible larva, determines the production of these results whenever green pupæ are produced by the influence of surroundings, *viz.*, when, as in nature, green pupæ of *Pieris* are produced on green leaves, that the effect is caused by the reflected yellow rays only.

Although no new conclusions can be drawn from these

interesting experiments, it is of high importance that the confirmation of recently-published results obtained by larger experiments and more accurate methods should be affoided by the work of an entirely independent investigator. Mr. Griffiths was, in fact, entirely unaware of Mr. Poulton's conclusions, and imagined that the foimer theory of "photographic susceptibity" on the part of the freshly-formed pupa accounted for the facts. It is therefore interesting to note that, had not this latter theory been already entirely upset by Mr. Poulton's investigations, it would have been equally disproved by the experiments recorded in the present paper.

XI. *A catalogue of the* Lepidoptera *of Sikkim, by* H. J. Elwes, F.L.S., F.Z.S., &c.; *with additions, corrections, and notes on seasonal and local distribution, by* Otto Moller.

Part I. RHOPALOCERA.

[Read February 1st, 1888.]

Plates VIII., IX., X., & XI.

Though the following catalogue is the result of many years' collecting in Sikkim by Mr. Moller, myself, and others, and though it includes a far larger number of species than have ever been recorded from any district in the Old World, yet I am afraid it will be still far from complete, at least so far as the Heterocera are concerned; but, though every year brings to light many new species from this wonderfully rich country, and our knowledge of many of those already known is very imperfect, yet I think the time has come when it may be of great use to lepidopterists both in India and elsewhere.

The greater part of what has been written on Indian Lepidoptera previous to Mr. de Nicéville's book is the work of those who have no local knowledge of the species they describe; and has been confined almost entirely to bare descriptions made without reference to the numerous allied forms which exist in other parts of the Indian region, and with much more narrow ideas of the variation of species than are characteristic of the best modern workers in all branches of natural history. It will be seen in the course of my list how numerous are the names which I have been obliged to consider as synonyms; and, though I have gone farther in this direction than any one who has previously worked at Oriental Lepidoptera, I honestly believe that in many cases I have hardly gone as far as facts would justify, though I have endeavoured to recognise as specific the most minute distinctions, when they appear to be constant or structural. In a local catalogue of this kind, however, which is rather a contribution to

geographical distribution than to systematic Entomology, my readers will not be too critical on this point, especially when they remember that no revision of the genera of butterflies exists more recent than that of Doubleday and Hewitson, to whom many of the species and supposed genera included in this list were entirely unknown; and though, for convenience' sake, I have followed the nomenclature and arrangement of Marshall and de Nicéville's work on the Butterflies of India so far as it extends, yet, however painstaking and admirable a book this may be, neither the time nor the man has yet arrived to do such work as it should be, and one day will be, done.

The materials at my disposal have been very ample, and, though it is a matter of great regret to me that the very large and fine collections made by Dr. Lidderdale and the late Mr. Atkinson in Sikkim should have been dispersed, without any complete record of their contents, yet Möller's indefatigable efforts have probably missed very few species procured by them; and, as he has freely placed at my disposal his unrivalled knowledge of Sikkim butterflies, I am able to give the range and season of most of them with tolerable exactness, which is of far greater importance to Science than the addition of a few bare names to a list which is already so extensive.

My own travels in Sikkim commenced in 1870, when I spent six months, from May to October inclusive, in the country, and visited the interior with Mr. Blanford, of the Geological Survey, when we went over a great part of the ground which had previously only been visited by Sir J. Hooker and the late Mr. Campbell. In this year I devoted my attention mainly to Ornithology, and on my return gave my collection of Lepidoptera to Mr. Godman. In the winter and spring of 1876, and again in 1880—81, I revisited Sikkim, but, owing to its being the dead season for insects on both these occasions, I added but little to my knowledge of them, though I became possessed of a very large collection formed between 1870 and 1881 by Mr. Wilson, which contained many species now very rare or extinct in British Sikkim. I also received, from my late friend Mr. L. Mandelli, many fine species of moths, and began, with Mr. Gammie's kind assistance, to employ native collectors in the interior

and on the Tibetan and Bhotan frontier, who have in successive years procured many species which do not occur in the outer and accessible parts of Sikkim.

In 1886 I received permission to accompany the embassy which the Indian Government intended to send under Mr. Colman Macaulay to Lhasa, and during the delay of the mission at Darjeeling I collected diligently in British Sikkim from May 18th to the end of August, and observed a large quantity of species in life, besides what I obtained through my native collectors and my friends Messrs. Moller, Gammie, de Nicéville, and Knyvett, to all of whom my best thanks are due for their great help and kindness in assisting my pursuits.

To Mr. Möller, however, I owe the greater part of the observations and notes here recorded, and, as this gentleman has been for ten years a resident in Sikkim, and has both personally and through native collectors steadily increased his knowledge of the Lepidoptera during this long period, I believe that no place in the tropics of the Old World has been worked so thoroughly as British Sikkim, or would so well repay the labour which he has devoted to it.

A very large number of the smaller species, especially the *Lycænidæ* and *Hesperidæ*, which were previously unknown or supposed to be very rare, are now taken in abundance by him and his men, and have been described and admirably figured by Mr. de Nicéville in the Journal of the Asiatic Society of Bengal and elsewhere.

A certain number of species which were collected by others, but which we have not personally procured, are included on the authority of Hewitson and Moore, but where I see any reason to doubt the correctness of the locality given I have not numbered these species in my list.

Though it would be impossible for me in the limits of a paper of this kind to describe in detail the physical features of Sikkim, which have been so faithfully and admirably described by Sir Joseph Hooker in his 'Himalayan Journals,' and by Hodgson in his numerous papers on the Natural History of the Himalayas; yet, in order to explain the wonderful wealth of natural productions in Sikkim, I must say a few words on this subject.

Sikkim is a small territory situated between Nepal and Bhotan, bounded on the north by Tibet and on the

south by the plains of Bengal. That part of it which is included in British territory, and which alone has been well explored by Europeans, is less than forty miles wide, and extends from the Singalelah range, which forms the Nepal boundary, to the great Tista river, which separates it from British Bhotan; and is not more than twenty or thirty miles from the Rangit river, which separates it from independent Sikkim, to the plains. Its highest elevation is on the north-western frontier, where the mountain called Sundukpho exceeds 12,000 ft. Sikkim consists for the most part of steep hills covered with virgin forest above 6000 ft., but cleared for tea and native cultivation down to about 1500 or 2000 ft., except in those places where the slopes are very steep, and in the bottoms of the deep tropical valleys which everywhere intersect the country. In the interior the mountains rise to the highest elevation in the world, none of the passes into Tibet being much under 15,000 ft. in elevation, and some over 18,000 ft.; but of this part of Sikkim we know comparatively little, owing to the many natural and political obstacles which still exist, and which have prevented this part of the Himalaya from being as well known as the north-western part of the range.

The forest consists of tall trees, varying very much in character according to the elevation, and mostly accompanied by a luxuriant undergrowth of shrubby and herbaceous vegetation or bamboos, which make it in many places almost impenetrable.*

The deep valleys of the Rangit and Tista, with their numerous tributary streams, are extremely hot and damp during the greater part of the year, and unhealthy, except in the dry season. The Eastern Himalayas have been divided by Hodgson (see Journal of the Asiatic Society of Bengal for 1835) into three zones of elevation, each of which has a very distinct fauna and flora; and, when writing on the distribution of Asiatic birds (Proc. Zool. Soc., 1873, p. 65), I showed that these three zones are perfectly characteristic of three different zoological provinces. The lower or tropical zone extending up to about 5000 ft., which is inhabited by plants, birds, and insects characteristic of the Indo-Malay region. The

* The character of the forest in different parts of Sikkim is very well described by Mr. Gamble in the first volume of the 'Indian Forester,' Calcutta, Central Press Co., 1876, where there is an excellent map of the district.

middle or temperate zone from 5000 up to about 10 or 12,000 ft., which, though mostly of subtropical character, is largely peopled by birds, plants, and insects peculiar to the mountainous region extending from Kashmir to Sumatra and Formosa, which I then christened the Himalo-Chinese subregion. Thirdly, the alpine zone, above 12,000 ft., which belongs to and is inhabited by forms peculiar to or characteristic of the Palæarctic region.*

But, though the distribution of Lepidoptera is very similar to that of birds, yet many of the genera as at present recognised are much more cosmopolitan in their range, and I do not find that the middle zone contains anything like the same proportion of peculiar species or genera of Lepidoptera in proportion to the lower one, as it does in the case of birds and plants. I also notice that the upper zone, especially in the outer hills, where the rainfall is much heavier than in the interior, is much poorer both in abundance and variety of species than might be expected from its great extent and elevation, and from the great number and variety of species which are found in the adjoining regions of Turkestan and China. This, however, may be accounted for by the extreme moisture of the climate, and the prevalence of rain and mist during the summer or rainy season, which lasts almost without intermission from May till October. It is also probable that a better knowledge of the drier valleys and mountains of the interior at an elevation of 9—14,000 ft. will add many new species to the few which we at present have obtained through our native collectors, as it must be remembered that no European has hitherto collected insects systematically at a higher elevation than 12,000 ft. in the Eastern Himalayas, and that the interior valleys are as yet practically untouched.

It seems to be unquestionable that a damp and sunless climate, even if warm, is much less favourable to the abundance of Diurnal Lepidoptera, both as regards individuals and species, than a dry sunny one, even if the summers are short and the winters severe; and therefore we find a far greater abundance of species and individuals of butterflies in the lowest valleys of Sikkim,

* *The mean temperature of Darjeeling, 7500 ft. elevation, is* about 55° Fahr.: monthly average, highest 64°, lowest 41°.

where there is more or less sun almost every day, even in the rainy season; than we do on the middle zone, where the forests which clothe the hill-sides above 6000 ft. attract the clouds and condense them into rain. And I particularly remarked, during the rainy season of 1886, that the zone of elevation from 4000 to 6000 ft., which is perhaps the richest of all in birds and plants, is comparatively much poorer in insects than the zones below it, partly, I believe, on account of the comparative want of sunshine, and partly on account of the extensive clearing of forest for cultivation, which has been going on much more extensively and rapidly since the introduction of tea cultivation. This observation, however, does not apply to the Heterocera, for, on the contrary, I found all families of moths except *Sphingidæ*, and the day-flying *Chalcosiidæ* and *Agaristidæ*, infinitely more abundant both in individuals and species at from 6000 to 9000 ft. than they are between 4000 and 6000 ft. And though, owing to the unhealthy climate of the valleys below 2000 ft., especially at night, I have had but little opportunity of collecting moths in the lowest valleys, yet I do not believe that they are so numerous in proportion to the butterflies as they are at Darjeeling itself, where at about 7000 ft. elevation, in a single night, I collected above 120 species of Heterocera.

With regard to the notes on elevations, and months of appearance of species given in this paper, I must say that they cannot pretend to be more than approximately correct, as, though they are drawn up by Möller from seven years' experience, yet a large number of them are based on the specimens brought in weekly by his native collectors, and refer in many cases to species which neither he or I could ever have believed to be half as numerous as they are if we had relied on our own observations alone. The assistance which we have derived from these native collectors is very great, and some of the Lepchas, who have been encouraged to persevere in taking the smaller and less conspicuous species, have developed a talent for collecting which any European might envy. Living as they do in the low valleys, able to endure an extreme of damp heat which is most exhausting to us, and knowing by long experience the exact spots, and the seasons when the rarer species are to be found, they have procured in abundance,

and in splendid condition, many species whose existence was a few years ago quite unexpected. But to the higher elevations, where they feel the cold much more than we do, they will not go willingly, or work half as well as they do below, and so it happened that on my first visit to Tonglo, a mountain 10,000 ft. high, on the Nepal frontier, and only twenty miles from Darjeeling, I took in great abundance several butterflies which had hitherto been thought extremely rare, and three which were undescribed, besides a great number of Heterocera which are quite unknown to Science.

Again, as to the dates which are given for the occurrence of the different species, I may say that in the case of insects inhabiting the hot valleys below 3000 ft., which form so large a proportion of the whole, the season begins early in March, when the first broods of many species begin to fly. During April and May the numbers of individuals and species increases to its maximum, and those species of *Papilio* and others which we believe to be single-brooded come out at this time. Occasional heavy rains commence in May, which about the 15th of June become much more continuous, lasting with almost daily bright intervals in the lower valleys; but with only an hour or two of sunshine in the early morning, or rare breaks of a week or ten days of fine weather at the higher levels, until September or October. This, however, is the season when butterflies are comparatively most numerous at the higher levels and less abundant in the hot valleys, but, though we cannot say so with certainty, we believe that an irregular succession of broods of most species appear throughout the rainy season, which at the close of the rains assume increased proportions; so that October is, next to April, the best month for collecting in the tropical zone. From October the number of species rapidly decreases till the end of the year, when a few only are found in the lowest valleys and outer hills. During January and February there is almost a cessation of butterfly-life, though even then some species can always be found on sunny days. But in dividing the year for entomological purposes in this part of the tropics we can define three seasons. First, the hot from March to June. Secondly, the wet season from June to October, when about 8-10ths of the annual rainfall occurs. This varies in Sikkim from about

80 or 90 in. at Pashok and Badamtam,* which are low down behind the great forest-covered hill of Sinchul; on a northern spur of which Darjeeling stands; to 150 or 180 in. at Rungbi and Kursiong. When a seasonal variation occurs in the markings and ocellation of certain species, which has been proved to be the case by Messrs. de Nicéville and Möller, it may be expected in the broods appearing at the beginning of the hot season, and at the beginning and end of the rainy seasons; but, as these periods are more or less variable and not defined so sharply as in the plains, so also do we find the seasonal forms less sharply defined, and sometimes connected by intermediate varieties, as is also the case in some European and American species. It must also be remembered in connection with this subject that the period required for the completion of the preliminary stages in Lepidoptera is much shorter in a tropical than in a temperate climate, and that it is therefore more difficult to lay down any rule for the appearance of seasonal forms. Lastly, we have a period of cold weather lasting from November till February, and accompanied by some rain, mist, and hoar-frost at elevations of 5—7000 ft., which is almost a dead season for butterflies, though in the Terai and lowest valleys a considerable number of species may be taken even at this season.

It must not be supposed, from a perusal of this list, that many of the species which I have marked as common are common in the sense that we sometimes use the word. I have spent many months without once seeing insects, which, though abundant in certain spots or at certain seasons, are by no means generally distributed; and, though I am inclined to say of butterflies what Sir Joseph Hooker says of plants, namely, that they are not so local or narrowly limited in their range in the Himalayas as in Europe, yet it would require some years of diligent search to obtain anything like an idea of the variety which really exist even in such a restricted locality as Sikkim. And for this reason I think but little importance can be attached to generalisations based on a few weeks or even a few months of

* At Singla, elevation 2000 ft., in 1884 only 48 in. were recorded, but the average is about 80 in.

collecting by travellers in tropical countries, as such collections rarely contain more than the commoner species. I should expect an active and experienced collector to take 90 per cent. of the butterflies which existed in a district like the Alps or Pyrenees in one season, whilst in such a region as Sikkim I do not think he would take 50 per cent., though the season lasts at least twice as long. And, notwithstanding the wonderful number of butterflies which occur in the lower valleys of Sikkim, I have never been able to take in one day so many species as I have done in one day in the Italian valleys of the Alps, whilst in the middle and upper zones I should not expect to take more than twenty to thirty species of Rhopalocera on the most favourable day, and such a day might occur perhaps only half-a-dozen times in the whole season. As to the Heterocera, I do not believe that a lifetime would exhaust them, as every change of locality brings a number of new species, and many species only seem to be taken at intervals of several years.

In order to compare the characteristics and abundance of the butterfly fauna of Sikkim with that of adjoining regions of a similar character, I have selected two of which we have the best, though not a complete knowledge; namely, the Malay Peninsula and the North-west Himalayas.

For the first I have taken Mr. Distant's catalogue of butterflies as it stands in his recently-completed work, 'Rhopalocera Malayana,' though I believe that if he had worked on such ample materials as I have done he would have added many good species to this list, and at the same time omitted many which he treats as species, though without any proof that they are so.

For the North-west Himalaya I have compiled a catalogue from various sources, of which the principal are the lists of Capt. Lang's collection in Proc. Zool. Soc., 1865, and Mr. Hockings, in Proc. Zool. Soc., 1882, both worked out by Moore. I have also used the paper on the Butterflies of Kumaon by Doherty, in the Journal of the Asiatic Society for 1886, and some MSS. notes on the Butterflies of Kangra, Kulu, and Lahoul, sent me by Capt. Graham Young. As almost all the species described in these papers are well represented in my own collection, I am able to say that this list is fairly

accurate and complete, though I have omitted many names which do not represent distinct species. I have also omitted in the north-west list all those species which, as far as we know, only occur in Ladak, and do not strictly belong to the Himalayan fauna. The majority of the Sikkim species no doubt extend to the Khasia and other hill-ranges of Assam, but we have no sufficiently complete list from those ranges with which to make a comparison.

A study of these three lists will show how much richer Sikkim is in species, than the countries on either side of it, the reason being that the very hot and wet climate of the lower valleys enables a large proportion of the Malayan species, and many peculiar ones of similar character to exist in them; whilst the immense forests of the middle zone contain a large number of species for which the Malay Peninsula, as far as we at present know it, is not equally well fitted. In North-west Himalaya it will be seen that the number of these Malayan and peculiar Himalayan forms is much less, and, though a proportion of them occur as far west as Kumaon, yet they rapidly diminish as we go towards Kashmir; whilst, on the other hand, a number of genera and species of more Palæarctic character begin to appear in Kumaon, and increase in the extreme north-west on account of the great diminution in the rainfall and much drier and sunnier climate of the middle and upper zones as compared with the Eastern Himalayas.

I think, however, that if it were possible to explore thoroughly the valleys and mountains of the Mishmi and Abor hills in the extreme Eastern Himalayas, we should find a fauna, if not so rich in number of species, yet even more peculiar and interesting than that of Sikkim, and including probably a number of species which are more closely allied to those of Western China and Eastern Tibet, of which at present we know so little, though that little is of surpassing interest.

COMPARATIVE LIST OF THE BUTTERFLIES FOUND IN SIKKIM WITH THOSE OF THE MALAY PENINSULA AND THOSE OF THE NORTH-WEST HIMALAYA FROM KASHMIR TO KUMAON.

MALAY PENINSULA.	SIKKIM.	N.W. HIMALAYA.
	NYMPHALIDÆ.	
	DANAINÆ.	
1 Hestia lynceus		
2 H. linteata		
3 H. leuconoe		
4 Idæopsis daos		
5 Danais vulgaris		
6 D. juventa		
	1 Danais melanoides	1 Danais melanoides
7 D. aspasia v. crocea		
8 D. tytia	2 D. tytia	2 D. tytia
9 D. melaneus	3 D. melaneus	
	4 D. limniace	3 D. limniace
10 D. agleoides		
11 D. septentrionis	5 D. septentrionis	4 D. septentrionis
D. chrysippus	6 D. chrysippus	5 D. chrysippus
12 D. genutia	7 D. genutia	6 D. genutia
13 D. melanippus v. hegesippus		
14 D. abigar		
15 Euplœa malayica		
16 E. bremeri		
17 E. marsdeni		
18 E. castelnaui		
19 E. midamus	8 Euplœa midamus	7 Euplœa midamus
20 E. mulciber		
21 E. ledereri		
22 E. vestigiata		
23 E. diocletianus	9 E. rhadamanthus	
24 E. crassa	10 E. rogenhoferi	
25 E. dejeani	11 E. Klugii }	
26 E. chloe	E. Kollari }	
27 E. margarita	12 E. core	8 E. core
28 E. distanti	13 E. deione	
29 E. godarti	14 E. hopei	
30 E. menetriesi	? alcathoe	
31 E. pinwilli		
32 E. harrisi		
	SATYRINÆ.	
33 Cœlites epiminthea	15 Anadebis himachala	
34 C. euptychiodes		
35 Mycalesis anaxias	16 Mycalesis anaxias	
	17 M. sanatana	9 Mycalesis sanatana
	M. gopa	
36 M. medus	18 M. medus	
	M. runeeka	
37 M. blasius	19 M. blasius	
	M. perseus	10 M. perseus
38 M. mineus	20 M. mineus	11 M. mineus

SATYRINÆ—continued.

Malay Peninsula.	Sikkim.	N.W. Himalaya.
39 Mycalesis orseis	Mycalesis visala	
40 M. maianeas	M. indistans	
41 M. nautilus		
42 M. mnasicles		
43 M. fusca	21 M. suaveolens	12 Mycalesis heri
	22 M. malsara	13 M. malsara
44 M. anapita	23 M. rudis	
45 M. janardana	24 M. nicotia	
46 M. ustulata	M. Langi	
47 Neorina Lowii, var.	25 Neorina margaritæ	
	26 N. hilda	
	27 Lethe scanda	
48 Lethe minerva	28 L. bhairava	
	29 L. latiaris	
	30 L. sinorix	
	31 L. kansa	
	32 L. vindhya	
49 L. mekara	33 L. mekara	
	34 L. distans	
	35 L. chandica	
50 L. europa	36 L. europa	14 Lethe europa
	37 L. dyrta	15 L. dyrta
	38 L. dinarbas	16 L. hyrania
	39 L. rohria	17 L. rohria
	40 L. verma	18 L. verma
	41 L. masoni	19 L. vaivarta
	42 L. siderea	
	43 L. sidonis	20 L. sidonis
	44 L. maitrya	21 L. maitrya
	45 L. serbonis	
	46 L. nicetella	
	47 L. nicetas	
	48 L. visrava	
	? ♀ deliades	
	49 L. tristigmata	
	50 Zophoessa sura	
	51 Z. dura	
	52 Z. goalpara	22 Zophoessa goalpara
	53 Z. atkinsonia	
	54 Z. baladeva	23 Z. baladeva
	55 Z. ramadeva	
	56 Z. jalaurida	24 Z. jalaurida
	57 Z. mölleri	
	58 Z. yama	25 Z. yama
	59 Neope bhadra	
	60 N. pulaha	26 Neope pulaha
	61 Orinoma damaris	27 Orinoma damaris
	62 Raphicera satricius	28 Raphicera satricius
	63 R. moorei	29 R. moorei
		30 Pararge kashmeriensis
		31 P. schakra
		32 P. menava
		33 Satyrus parisatis

MALAY PENINSULA.	SIKKIM.	N.W. HIMALAYA.
	SATYRINÆ—continued.	
		34 S. semele
		35 S. hubneri
		36 S. brahminus
	64 Satyrus padma	37 S. padma
	65 S. loha	38 S. loha
	66 S. brahminus	
	? S. saraswati	39 S. saraswati
		40 S. swaha
		41 Epinephele davendra
		42 E. cheena
		43 E. pulchra
		44 E. cœnonympha (maiza)
51 Yphthima pandocus	67 Yphthima philomela	45 Yphthima philomela
52 Y. methora ?	68 Y. methora	46 Y. asterope
53 Y. newboldi	69 Y. newara	47 Y. nareda
	70 Y. sakra	48 Y. sakra
54 Y. fasciata		49 Y. avanta
55 Y. hübneri	71 Y. hübneri	
56 Erites angularis		
	72 Oeneis pumilus var.	50 Oeneis pumilus
57 Ragadia crisia		51 Erebia shallada
		52 E. kalinda
		53 Callerebia scanda
	73 Callerebia annada	54 C. annada
	74 Zipætes scylax	55 C. nirmala
		56 C. hyagriva
58 Melanitis leda	75 Melanitis leda	57 Melanitis leda
M. ismene	M. ismene	M. ismene
59 M. zitenius	75*b* M. zitenius	58 M. zitenius
60 M. suyudana	75*c* M. duryodana	
61 M. abdullæ		
	75*d* M. aswa	59 M. aswa
	ELYMNIINÆ.	
	76 Cyllogenes suradeva	
62 Elymnias discrepans	77 Elymnias undularis	60 Elymnias undularis
63 E. nigrescens	78 E. leucocyma	61 E. leucocyma
64 E. lutescens	79 E. patna	62 E. patna
65 E. lais	80 E. vasudeva	
66 E. penanga	81 E. timandra	
67 E. abrisa		
68 E. casiphone		
69 E. saüeri		
70 E. künstleri		
71 E. godferyi		
72 Discophora celinde	82 Discophora celinde	
73 D. tullia var.	83 D. tullia	
74 D. sondiaca	84 D. spiloptera	
	MORPHINÆ.	
	85 Enispe euthymnius	
	86 E. cycnus	

MORPHINÆ—continued.

Malay Peninsula.	Sikkim.	N.W. Himalaya.
75 Thaumantis lucipor	87 Thaumantis diores	
76 T. noureddin	88 Stictopthalma camadeva	
77 T. odana	89 S. nourmahal	
78 T. pseudaliris		
79 Clerome arcesilaus	90 Clerome arcesilaus	
80 C. gracilis	91 Amathusia portheus	63 Amathusia sp.
81 C. faunula		
82 Amathusia phidippus		
83 A. dilucida		
84 Zeuxidia amethystus		
85 Z. doubledayi		
86 Z. aurelius		
87 Tenaris birchi		
88 Xanthotænia busiris		

NYMPHALINÆ.

Malay Peninsula.	Sikkim.	N.W. Himalaya.
	92 Pareba vesta	64 Pareba vesta
	93 Telchinia violæ	65 Telchinia violæ
89 Ergolis merione	94 Ergolis merione	
90 E. ariadne	95 E. ariadne	
91 E. isæus		
92 Euripus consimilis (Euplœoides)	96 Euripus consimilis	66 Euripus consimilis
93 E. halitherses	97 E. halitherses	
94 E. pfeifferæ		
95 Cupha erymanthis	98 Cupha erymanthis	67 Cupha erymanthis
	99 Melitæa sindura v. orientalis	68 Melitæa sindura
		69 M. balbita
96 Atella sinha	100 Atella sinha	70 Atella sinha
97 A. phalanta	101 A. phalanta	71 A. phalanta
98 A. alcippe	102 A. alcippe	
99 Cethosia logani	103 Cethosia cyane	
100 C. methypsea		
101 C. biblis	104 C. biblis	
102 C. hypsina		
103 Cynthia deione	105 Cynthia erota	
104 C. cantori	106 Helcyra hemina	
105 Rhinopalpa fulva		
	107 Sephisa chandra	72 Sephisa dichroa
106 R. ? eudoxia		
	108 Apatura namouna	73 Apatura namouna
107 Prothoe uniformis	109 A. chevana	
108 P. angelica	110 A. parvata	
109 P. caledonia		
	111 A. sordida	74 Dilipa morgiana
	112 A. parisatis	
110 Hestina nama	113 Hestina nama	
	114 H. persimilis	75 Hestina persimilis
		76 H. mena
	115 Herona marathus	

NYMPHALINÆ—continued.

Malay Peninsula.	Sikkim.	N.W. Himalaya.
111 Precis iphita	116 Precis iphita	77 Precis iphita
112 P. ida		
113 Junonia asterie	117 Junonia asterie	78 Junonia asterie
114 J. atlites	118 J. atlites	79 J. atlites
115 J. lemonias	119 J. lemonias	80 J. lemonias
116 J. wallacei		
	120 J. œnone	81 J. œnone
	121 J. orythia	82 J. orythia
117 Neptis hordonia	122 Neptis hordonia	83 Neptis hordonia
118 N. peraka	123 N. radha	
119 N. miah var.	124 N. miah	
120 N. dindinga	125 N. ananta	
121 N. tiga	126 N. viraja	
122 N. anjana var.		
123 N. ophiana	127 N. zaida	84 N. zaida
124 N. nata		85 N. narayana
125 N. leuconata	128 N. manasa	
	129 N. amba	86 N. amba
126 N. gononata	130 N. cartica	
127 N. vikasi	131 N. vikasi	87 N. vikasi
128 N. vikasi v. herita		
129 N. eurynome	132 N. varmona	88 N. varmona
130 N. duryodana var.	133 N. astola	89 N. ananta
131 N. charon		
	134 N. soma	90 N. soma
	134*b* N. adipala	
	134*c* N. susruta	91 N. susruta
		92 N. emodes
	135 N. nandina	93 N. nandina
132 N. ophiana	136 N. ophiana	
133 Cirrochroa clagia		94 N. mahendra
134 C. bajadeta		
135 C. malaya	137 Cirrochroa aoris	
136 C. rotundata	138 C. mithila	
	139 Pseudergolis wedah	95 Pseudergolis wedah
137 C. orissa		
138 C. satellita	140 Stibochiona nicea	96 Stibochiona nicea
139 C. (Paduca) fasciata		
140 Hypolimnas bolina	141 Hypolimnas bolina	97 Hypolimnas bolina
141 H. misippus	142 H. misippus	98 H. misippus
142 H. incommoda		
	143 Argynnis niphe	99 Argynnis niphe
143 H. anomala		
	144 A. childreni	100 A. childreni
	145 A. lathonia	101 A. lathonia
144 Tanæcia flora		
	146 A. gemmata	102 A. gemmata
145 T. supercilia	147 A. altissima	103 A. kamala
		104 A. niobe (jainadeva)
	148 A. pales	105 A. pales (sipora)
146 T. violaria		106 A. clara
147 T. pulasara		107 A. kashmiriensis
148 T. consanguinea		

Malay Peninsula.	Sikkim.	N.W. Himalaya.
	NYMPHALINÆ—continued.	
149 T. aruna		
150 T. robertsii		
	149 Dichorragia nesimachus	108 ? Dichorragia nesimachus
	150 Calinaga buddha	109 Calinaga buddha
151 T. nicévillei	151 Penthima lisarda	
152 Parthenos gambrisius	152 Neurosigma doubledayi	
153 Lebadea ismene	153 Lebadea ismene	
	154 Limenitis danava	110 Limenitis danava
154 L. martha	155 L. zulema	111 L. hydaspes
155 Pandita sinope	156 L. zayla	112 L. ligyes
	157 L. dudu	
156 Limenitis procris	158 L. procris	113 L. procris
157 Athyma perius	159 Athyma perius	114 Athyma perius
158 A. larymna var.	160 A. jina	115 A. asura
159 A. idita	161 A. mahesa	
160 A. pravara	162 A. orientalis	116 A. opalina
	163 A. selenophora	117 A. selenophora
161 A. abiasa v. clerica		
	164 A. zeroca	118 A. zeroca
162 A. kresna		
163 A. amhara var.		
	165 A. cama	119 A. cama
164 A. nefte v. nivifera	166 A. inara	
165 A. subrata	167 Abrota ganga	
166 A. urvasi		
167 Symphædra dirtæa	168 Symphædra nais	120 Symphædra nais
168 S. pardalis		
169 S. ? emalea		
170 Euthalia derma	169 Euthalia nara	121 Euthalia doubledayi
171 E. durga	170 E. durga	
172 E. bellata	171 E. sahadeva	
173 E. parta	172 E. duda	
174 E. merta	173 E. franciæ	
175 E. garuda	174 E. garuda	122 E. garuda
176 E. laverna	175 E. phemius	
177 E. ziehri	176 E. jama	
178 E. jama		
179 E. lubentina	177 E. lubentina	123 E. lubentina
180 E. adonia var.		
181 E. lepidea var.	178 E. lepidea	
182 E. bipunctata	179 E. telchinia	
183 E. decorata		
184 E. ramada		
	180 E. apiades	124 E. apiades
185 E. macnairi	181 E. jahnu	
186 E. stoliczkana	182 E. kesava	
187 E. maclayi		
188 E. cocytina		
189 E. anosia	183 E. anosia	
190 E. puseda		

NYMPHALINÆ—continued.

Malay Peninsula.	Sikkim.	N.W. Himalaya.
191 Euthalia asoka		
192 E. xiphiones	184 Vanessa cardui	125 Vanessa cardui
	185 V. indica	126 V. indica
193 Vanessa perakana	186 V. canace	127 V. canace
194 Terinos robertsia	187 V. antiopa	128 V. antiopa
	188 V. kashmirensis	129 V. kashmirensis
195 T. teuthras		130 V. l-album
	189 V. rizana	131 V. rizana
		132 V. xanthomelas
	190 V. ladakensis	133 V. ladakensis
	191 V. c-album v. tibetana	134 V. c-album
196 Symbrenthia hypoclus	192 Symbrenthia hypoclus	135 Symbrenthia hypoclus
197 S. hypatia		
	193 S. hypselis	136 S. hypselis
198 Eulacura osteria	194 S. niphanda	
199 Chersonesia rahria	195 S. silana	
200 C. peraka		
201 Cyrestis cocles	196 Cyrestis cocles	
202 C. nivea v. nivalis		
203 C. formosa		
204 C. periander		
	197 C. thyodamas	137 Cyrestis thyodamas
205 C. earlii	198 C. risa	138 C. risa
206 Kallima buxtoni v.	199 Kallima inachus	139 Kallima inachus
207 Doleschallia pratipa	200 Doleschallia polibete	140 K. hugeli
208 Charaxes echo	201 Charaxes dolon	
209 C. schreiberi		
210 C. delphis		
	202 C. eudamippus	141 Charaxes eudamippus
211 C. athamas	203 C. athamas	142 C. athamas
212 C. hebe	204 C. arja	
213 C. moori		
	205 C. fabius	143 C. fabius
214 C. jalysus	206 C. marmax	
	207 C. lunawara	144 C. lunawara
215 C. durnfordi	208 C. aristogiton	145 C. hemana
216 C. borneensis var.		
	209 C. hierax	146 C. hierax
217 C. harpax	210 C. pleistoanax	
218 C. baya		
219 C. distantia		

MALAY PENINSULA.	SIKKIM.	N.W. HIMALAYA.
	LEMONIIDÆ.	
	LYBITHÆINÆ.	
220 Libythea myrrha	211 Libythea myrrha	147 Libythea myrrha
	212 L. lepita	148 L. lepita
	NEMEOBIINÆ.	
221 Zemeros albipunctata	213 Zemeros flegyas	
222 Z. emesoides		
	214 Dodona dipæa	149 Dodona dipæa
	215 D. eugenes	150 D. eugenes
223 Simiskina fulgens		
		151 D. durga
	216 D. ouida	152 D. ouida
224 Stiboges nymphidia	217 D. egeon	
	218 D. adonira	
225 Abisara savitri		
	219 Abisara fylla	153 Abisara fylla
226 A. neophron	220 A. neophron	
227 A. kausambi	221 A. chela	154 A. suffusa
228 A. haquinus		
229 A. thuisto		
230 A. tanita		
231 A. telesia		
232 A. damajanti		
	LYCÆNIDÆ.	
233 Poritia sumatræ	222 Poritia hewitsoni	155 Poritia hewitsoni
234 P. phraatica		
235 P. pharyge		
236 P. pleurata		
237 P. phalena		
238 P. pheretia		
239 P. pediada		
240 P. potina		
241 Curetis malayica	223 Curetis thetys	156 Curetis thetys
242 C. æsopus	? 224 C. bulis	157 C. bulis
243 C. felderi		
244 C. insularis		
245 C. sperthis		
246 Loxura atymnus	225 Loxura atymnus	
247 L. cassiopeia	226 L. tripunctata	
248 — marciana		
249 Liphyra brassolis	227 Liphyra brassolis	
250 Gerydus symethus	228 Gerydus drumila	
251 G. biggsii		
252 Paragerydus horsfeldi		
253 P. nivalis		
254 Allotinus unicolor	229 Allotinus multistrigatus	158 Allotinus multistrigatus
255 A. alkamah	230 Miletus boisduvalli	

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	LYCÆNIDÆ—*continued.*	
256 Neopithecops horsfeldi	231 Neopithecops zalmora	159 Neopithecops zalmora
	232 N. hamada	
257 Megisba thwaitesi	233 Megisba malaya (thwaitesi)	160 Megisba thwaitesi
	234 Spalgis epius	
258 Cyaniris lambi	235 Cyaniris puspa	161 Cyaniris puspa
	236 C. marginata	162 C. marginata
	237 C. albocæruleus	163 C. albocæruleus
259 C. haraldus	238 C. transpectus	
260 C. placida	239 C. placida	
	240 C. dilectus	164 C. dilectus
		165 C. cælestina
		166 C. hugeli
261 C. sp.		167 C. vardhana
262 C. jynteana	241 C. jynteana	
263 Zizera lyzizone		
	242 Zizera putli	168 Zizera putli
264 Z. pygmæa		169 Z. pygmæa
265 Z. karsandra		170 Z. karsandra
	243 Z. sangra	171 Z. sangra
266 Z. ? usta		
	244 Lycæna maha	172 Lycæna maha
	245 L. theophrastus	173 L. theophrastus
		174 L. alteratus
	246 L. plinius	175 L. plinius
		176 L. galatea
		177 L. omphisa
267 Lycæna bœtica	247 L. bœtica	178 L. bœtica
	248 L. pheretes v. asiatica	
		179 L. astrarche (nazira)
268 L. parrhasius	249 L. parrhasius	
		180 L. ariana
269 Jamides bochus	250 Jamides bochus	
270 Lampides optimus		
271 L. abdul		181 L. pseuderos
272 L. kankena		182 L. dipora
		183 L. baton (vicrama)
		184 L. ellisi
	251 Chilades laius	185 Chilades laius
	252 C. pontis	
273 L. ælianus	253 Lampides ælianus	186 Lampides ælianus
274 L. elpis	254 L. elpis	
275 Catochrysops strabo	255 Catochrysops strabo	187 Catochrysops strabo
276 C. cnejus	256 C. cnejus	188 C. cnejus
277 C. pandava	257 C. pandava	189 C. pandava
		190 Azanus ubaldus
		191 A. gamra
278 Castalius ethion	258 Castalius decidea	
279 C. elna	259 C. interruptus	
	260 C. ananda	
280 C. roxus	261 C. roxus	

Malay Peninsula.	Sikkim.	N.W. Himalaya.
	LYCÆNIDÆ—*continued.*	
281 Castalius rosimon	262 Castalius rosimon	192 Castalius rosimon
282 Nacaduba beroë	263 Nacaduba ardates	193 Nacaduba ardates
283 N. macropthalma	264 N. macropthalma	
284 N. aluta	265 N. atrata	
285 N. kerriana	266 N. bhutea	
286 N. almora?		
	267 N. dana	194 N. dana
287 N. viola	268 N. viola	
288 N. sp.		195 N. cælestis
289 Lycænesthes bengalensis	269 Lycænesthes bengalensis	
290 L. lycænina	270 L. lycambes	196 Polyommatus phlæas
291 L. tessellata	271 L. cymbia	
292 Catapæcilma elegans	272 Catapæcilma elegans	
293 C.? bubases	273 C. delicatum	197 P. pavana
		198 P. kasyapa
294 Horaga halba	274 Horaga onyx	199 Horaga onyx
	275 H. viola	200 H. viola
	276 H. sikkima	
295 Deramas livens	277 Aphneus himalayensis	201 Aphneus himalayensis
		202 A. vulcanus
	278 A. elima	203 A. elima
296 Aphneus syama	279 A. syama	
297 Tajuria longinus	280 Tajuria longinus	204 Tajuria longinus
298 T. mantra	281 T. diæus	
299 T. relata	282 T. albiplaga	
300 T. travana	283 T. melastigma	205 Remelana yajna
	284 T. istroidea	
301 Bindahara phocides	285 Bindahara phocides	
302 Drupadia moorei	286 Iolaus illurgis	
303 Biduanda thesmia	287 I. maculatus	
304 B. lapithis	288 I. cotys	
305 Semanga superba	289 Sithon jangala	
306 Sithon nedymond	290 S. jalindra	
307 S. chitra	291 S. mandarinus	
308 Dacalana vidura	292 Camena ctesia	
309 Jacoona anasuja		
310 Cheritra freja	293 Cheritra freja	206 Cheritra freja
	294 C. acte	207 C. acte
311 Neocheritra amrita	295 Cheritrella truncipennis	
312 N. gama	296 Myrina symira	
313 Sinthusa amba	297 M. cyara	
314 S. amata	298 M. melisa	
315 Neomyrina hyemalis	299 M. fabronia	208 Myrina milionia
	300 Hypolycæna kina	209 Hypolycæna kina
	301 H. othona	210 H. othona

Malay Peninsula.	Sikkim.	N.W. Himalaya.
	LYCÆNIDÆ—*continued.*	
316 Purlisa gigantea		
317 Hypolycæna tharis		
318 H. thecloides		
	302 Hypolycæna virgo	
	303 H. chandrana	211 Hypolycæna chandrana
	304 H. nasaka	212 H. nasaka
319 H. erylus	305 H. erylus	
320 H. etolus	306 H. etolus	
321 Rapala amisena	307 Rapala orseis	213 Rapala grisea
322 Deudorix sequeira		
	308 R. schistacea	214 R. schistacea
323 D. utimutis	309 R. distorta	
324 D. jarbas	310 Deudorix jarbas	215 Deudorix jarbas
	311 D. nissa	216 D. nissa
325 D. domitia		
326 D. epijarbas	312 D. epijarbas	217 D. epijarbas
327 D. barthema	313 D. petosiris	218 D. melampus
328 D. xenophon	314 D. amyntor	219 Hydsura selira
	315 Virachola perse	220 Virachola isocrates
329 Iraota boswelliana	316 Iraota timoleon	221 Iraota timoleon
330 I. nila		
	317 I. mæcenas	222 I. mæcenas
	318 Pratapa bhotea	223 Pratapa deva
	319 Ilerda epicles	
	320 I. androcles	224 Ilerda androcles
		225 I. tamu
		226 I. oda
	321 I. brahma	227 I. brahma
		228 I. sena
	322 I. moorei	229 I. moorei
	323 Thecla duma	
	324 T. syla	230 Thecla syla
331 Amblypodia narada	325 Amblypodia camdeo	231 T. ataxus
		232 T. birupa
332 A. agnis	326 A. amantes	
333 A. anthelus	327 A. eumolphus	233 T. icana
334 A. maxwelli		
335 A. centaurus		234 T. mandara
336 A. farquhari	328 A. centaurus	235 T. deria (sassanides)
337 A. adatha	329 A. asoka	236 T. odata
338 A. atosia	330 A. adriana	
339 A. antimuta	331 A. areste	
340 A. aroa	332 A. molleri	
341 A. metamuta	333 A. fulgida	
	334 A. bazalus or bupola	
342 A. amphimuta		
343 A. kurzi	335 A. abseus	
344 A. ameria	336 A. ænea	
345 A. anniella	337 A. singla	
346 A. lycænaria	338 A. teesta	
	339 A. atrax	
	340 A. quercetorum	237 Amblypodia quercetorum

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	LYCÆNIDÆ—*continued.*	
	341 A. rama	238 A. rama
347 Amblypodia buxtoni	342 A. perimuta	239 A. dodonæa
348 A. vihara	343 A. paramuta	
349 A. inornata	344 A. paraganeesa	240 A. ganeesa
350 A. achelous		
351 A. ammon		
352 Panchala diardi		
353 P. singapura		
354 P. apidanus		
355 P. morphina		
356 P. trogon		
	PAPILIONIDÆ.	
	PIERINÆ.	
357 Pontia xiphia	345 Pontia xiphea	
358 Delias dione	346 Delias pasithoe	
359 D. parthenope		
360 D. pyramus	347 D. pyramus	
	348 D. eucharis	241 Delias eucharis
361 D. descombesi	349 D. descombesi	
362 D. ninus	350 D. hierte	
363 D. hyparete	351 D. agostina	
	352 D. belladonna	242 D. belladonna
364 D. singapura	353 Prioneris thestylis	243 D. v. ? sanaca
365 D. orphne		
366 Prioneris clemanthe	354 P. clemanthe	
	355 Catopsilia pyranthe	244 Catopsilia pyranthe
367 Catopsilia scylla	356 C. gnoma	245 C. philippina
368 C. chryseis		
369 C. catilla	357 C. catilla	246 C. catilla
370 C. crocale	358 C. crocale	247 C. crocale
371 Udaiana cynis		
372 Terias hecabe	359 Terias hecabe	248 Terias hecabe
373 T. tilaha	360 T. rubella	249 T. drona
	361 T. læta	250 T. læta
374 T. harina	362 T. harina	251 Gonepteryx nepalensis
	363 T. venata	
375 Dercas gobrias	365 Dercas verhueli	252 G. zaneeka
	366 D. wallichii	
	364 Colias Fieldii	253 Colias Fieldii
		254 C. hyale
		255 C. eogene
	367 Pieris agathon	256 Pieris agathon
		257 P. phryxe
	368 P. Dubernardi	258 P. soracta
		259 P. nabellica
	369 P. canidia	260 P. canidia
	370 P. brassicæ	261 P. brassicæ
	371 P. melete	262 P. melete
	372 P. mesentina	263 P. mesentina
		264 P. callidice
		265 P. daplidice
	373 Appias phryne —	266 Appias phryne

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	PIERINÆ—continued.	
	374 A. nerissa	267 A. nerissa
376 Appias hippo	375 A. nama	268 Anthocharis belia (venosa)
377 A. enarete	376 A. paulina	
378 A. leis	377 A. hippoides	
379 A. cardena		
380 A. leptis v. plana		
381 A. amalia		
382 A. andersoni		
383 A. nero	378 A. nero	
384 A. lagela	379 A. lalage	
385 Saletara pandia	380 Tachyris indra	
386 S. nathalia	381 Ixias evippe	269 Ixias evippe
387 Ixias birdi		270 I. marianne
388 Hebomoia glaucippe	382 Hebomoia glaucippe	
389 Eronia lutescens	383 Eronia avatar	
390 E. hippia	384 E. hippia	271 Eronia hippia
	PAPILIONINÆ.	
	385 Teinopalpus imperialis	
391 Ornithoptera rhadamanthus	386 Ornithoptera rhadamanthus	
392 O. pompeus (ruficollis)	387 O. pompeus	
393 O. hephæstus		
394 O. brookeana		
395 Papilio varuna	388 Papilio astorion	
396 P. erebus	389 P. aidoneus	
	390 P. ravana	272 Papilio ravana
	391 P. plutonius	
397 P. neptunus	392 P. Latreillei	
398 P. doubledayi	393 P. dasarada	
	394 P. philoxenus	273 P. philoxenus
	395 P. janaka	
399 P. aristolochiæ	396 P. aristolochiæ	274 P. aristolochiæ
	397 P. paris	275 P. paris
400 P. brama	398 P. krishna	276 P. polyctor
	399 P. arcturus	277 P. arcturus
	400 P. ganeesa	
401 P. androgeus	401 P. androgeus	
	402 P. protenor	278 P. protenor
	403 P. rhetenor	
402 P. helenus	404 P. helenus	279 P. helenus
403 P. iswara	405 P. chaon	
404 P. prexaspes		
405 P. polytes	406 P. polytes	280 P. polytes
406 P. nephelus		
407 P. erithonius	407 P. erithonius	281 P. erithonius
408 P. butleri		

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	PAPILIONINÆ—continued.	
409 P. caunus v. ægialus	408 P. slateri	
410 P. sycorax	409 P. polymnestor	
411 P. clytia	410 P. clytia	282 P. clytia
412 P. panope	411 P. panope	283 P. panope
413 P. megarus	412 P. megarus	
414 P. leucothoe	413 P. xenocles	
415 P. delesserti	414 P. macareus	
	415 P. agestor	284 P. agestor
416 P. demolion	416 P. epycides	285 P. govindha
	417 P. glycirion	
	418 P. paphus	
417 P. agetes	419 P. agetes	
418 P. antiphates	420 P. antiphates	
419 P. anticrates var.	421 P. anticrates	
	422 P. cloanthus	286 P. cloanthus
420 P. sarpedon	423 P. sarpedon	287 P. sarpedon
	424 P. eurypilus	288 P. eurypilus
421 P. evemon		
422 P. telephus		
423 P. bathycles	425 P. bathycles	
424 P. agamemnon	426 P. agamemnon	289 P. agamemnon
	427 P. gyas	
425 Leptocireus meges	428 P. machaon	290 P. machaon
	429 P. castor	
426 L. curius		
	PARNASSIINÆ.	
	430 Parnassius hardwickei	291 Parnassius hardwickei
	431 P. Jacquemonti	292 P. Jacquemonti
	432 P. acco	293 P. acco
		294 P. charltonius
		295 P. actius v. Himalayensis
		296 P. Stoliczkanus
	HESPERIDÆ.	
427 Unkana batara	433 Badamia exclamationis	
428 U. elia		
429 U. attina		
	434 Choaspes benjamini	297 Choaspes benjamini
430 Lotongus calathus	435 C. gomata	
431 L. maculatus		
432 Choaspes harisa	436 C. harisa	
433 C. crawfurdi	437 C. vasutana	
434 C. chuza	438 C. amara	
435 C. malayana	439 C. annadi	
	440 Ismene ædipodea	298 Ismene ædipodea
436 Paduka glandulosa	441 I. jama	
437 Pirdana hyela	442 Pirdana Rudolphei	
438 Hasora badra	443 Hasora badra	
439 H. vitta	444 H. chromus	

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	HESPERIDÆ—*continued.*	
440 Zea mytheca	445 Bibasis sena	
441 Matapa aria	446 Matapa aria	
	447 M. shalgrama	
	448 M. sasivarna	
	449 M. druna	
	450 Capila jayadeva	
	451 Pizzola zennara	
442 Pithauria murdava	452 Pithauria murdava	
	453 P. stramineipennis	
443 Baoris ? insignis		
444 B. oceia	454 Baoris oceia	
445 Chapra mathias	455 Chapra mathias	299 Chapra mathias
	456 C. prominens	300 C. prominens
446 Parnara moolata	457 Parnara guttatus	
447 P. narooa	458 P. colaca	301 C. karsana
	459 P. beavani	302 Parnara beavani
	460 P. assamensis	303 P. assamensis
448 P. ? chaya	461 P. pagana	
	462 P. plebeia	
	463 P. austeni	
	464 P. tulsi	
	465 P. toona	304 P. toona
	466 P. eltola	305 P. eltola
	467 Suastus gremius	306 Suastus gremius
	468 S. swerga	307 Syricthus kashmiriensis
	469 S. aditus	308 Spilothyrus alceæ
	470 Sarangesa dasahara	309 Sarangesa dasahara
449 Telicota bambusæ	471 Telicota bâmbusæ	310 Telicota bambusæ
450 T. augias	472 T. augias	
	473 T. dara	311 T. dara
451 T. goloides		
452 T. mæsoides	474 T. mæsoides	312 T. mæsoides
453 T. maro		313 T. maro
454 T. nigrolimbata	475 Pamphila ? avanti	314 Pamphila dimila (? comma)
	476 Cupitha purræa	315 P. brama
	477 Thanaos stigmata	316 Thanaos stigmata
	478 T. kali	
	479 T. jhora	
	480 Cyclopides subvittatus	317 Cyclopides subvittatus
455 Isma obscura	481 Halpe sikkima	
	482 H. separata	318 Halpe separata
456 I. bononia	483 H. kumara	
457 I. ? homolea	484 H. gupta	
	485 H. cerata	
	486 H. zema	
	487 H. dolopia	
	488 Taractocera mævius	319 Taractocera mævius (sagara)
	489 Isoteinon atkinsoni	

HESPERIDÆ—*continued.*

Malay Peninsula.	Sikkim.	N.W. Himalaya.
	490 I. masuriensis	320 Isoteinon masuriensis
	491 I. satwa	I. satwa
	492 I. cephala	321 Lobocla kasyapa
	493 I. pandita	
	494 I. flavipennis	
	495 I. flavalum	
458 Satarupa affinis	496 Satarupa gopala	
	497 S. sambara	322 Satarupa sambara
	498 S. bhagava	
	499 S. phisara	
	500 S. narada	
459 Tagiades atticus	501 Tagiades atticus	323 Tagiades atticus
460 T. gana	502 T. gana	
461 T. ravi	503 Pterygospidea syriothus	
462 T. dealbata		
463 T. lavata		
464 Antigonus sura	504 Antigonus sura	324 Antigonus sura
465 A. pygela	505 A. vasava	325 A. saraya
466 Casyapa phanæus	506 Darpa hanria	
467 Erionota thrax	507 Erionota thrax	
468 Gangara thyrsis	508 Gangara thyrsis	
469 Hidari irava	509 G. acroleuca	
470 H. sybirita	510 Chationeme Lidderdali	
471 H. staudingeri		
472 Plastingia callineura	511 Plastingia noemi	
473 P. hieroglyphica		
474 Hyarotis adrastus	512 Hyarotis adrastus	326 Hyarotis adrastus
475 Coladenia dan	513 Coladenia dan	327 Coladenia dan (fatih)
476 C. trichoneura var.	514 C. indrani	
	515 C. tissa	
	516 C. pralaya	
477 Udaspes folus	517 Udaspes folus	328 Udaspes folus
478 Plesioneura alysos	518 Plesioneura alysos	329 Plesioneura alysos
	519 P. dhanada	330 P. dhanada
479 P. asmara		
	520 P. nigricans	
480 P. pinwilli	521 P. badia	
	522 P. leucocirca	331 P. leucocirca
481 P. ? anthea	523 P. chamunda	
482 Kerana armata	524 P. agni	
483 K. *gemmifer*		
484 K. aurivittata		
	525 P. pulomaya	332 P. pulomaya
	526 P. sumitra	333 P. sumitra
485 Astictopterus diocles	527 Astictopterus diocles	
486 A. ? harmachis	528 A. Butleri	
487 A. jama		
488 A. salsala	529 A. salsala	
489 A. xanites	530 Barachus sp.	
490 A. sindu		

In studying this list it must be remembered that Sikkim, though it seems to have the greatest number of species, is but a very small area as compared to those from which the other two lists are taken. It is, however, much better explored than the Malay Peninsula, which doubtless contains many more species than those here enumerated, even when allowance is made for the reduction which would take place in the number if Mr. Distant's views as to specific variation were the same as my own.

Though the number of species in the North-west Himalaya seems small by comparison, yet I do not think that any one locality of the same area as Sikkim would give more than two-thirds of the number here included; and many of the tropical species included on Mr. Doherty's authority extend very little, if any, further west than Kumaon. In fact, it is clear that Sikkim is at least twice as productive in the variety of its butterflies than any place in the North-west Himalaya, and probably very much richer than any one locality in the Malay Peninsula. As the neighbourhood of Calcutta, which is, perhaps, better worked than any other place in the plains of Bengal, only affords about 160 species of butterflies (*cf.* de Nicéville in J. A. S. B., 1885), it is evident how important an influence a large extent of virgin forest has on the variety of Lepidoptera found in a tropical country.

It is not possible to analyse the distribution of the genera found in Sikkim very exactly, as some of them, especially among the *Lycænidæ*, are recently proposed, and are here adopted with some doubt; and I have been obliged to exclude the *Hesperidæ* entirely, on account of our ignorance of their classification, and their more cosmopolitan distribution; but I think the following results are sufficiently accurate for my purpose. I find, omitting the *Hesperidæ*, 121 genera, of which—

33, or about 27 per. cent., are of more or less cosmopolitan distribution in the Old World, though most of them confined to the tropics.

51, or about 42 per cent., are characteristic of and nearly peculiar to the Indo-Malay subregion, some of them extending, however, to the Austro-Malay subregion.

12, or about 10 per cent., are peculiar to the Himalayas and Indo-Malay subregion.
5, or about 4 per cent., are characteristic of the Himalayo-Chinese subregion, though one of them—*Lethe*—extends to Malayana.
12, or about 10 per cent., are peculiar to the Himalayas, some extending, however, to the mountains of Assam and Tenasserim and E. Tibet.
6, or about 5 per cent., are peculiar to or characteristic of the Palæarctic region.
2 are apparently confined to the Indian subregion.

Of the genera which I consider specially characteristic of Sikkim are as follows:—

Anadebis confined to Eastern Himalaya.
Zophoessa extends to Tenasserim.
Orinoma extends to Assam.
Raphicera extends to E. Tibet.
Cyllogenes extends to Bhutan.
Neurosigma extends to Assam.
Abrota confined to Sikkim.
Dodona extends to Tenasserim.
Camena extends to Khasia.
Ilerda extends to Java, Borneo, and E. Tibet.
Teinopalpus confined to Sikkim, and probably West Bhutan.

We have also three monotypic genera of *Hesperidæ* which at present have only been taken in Sikkim, *viz.*:—

Capila jayadeva.
Pizzola zennara.
Dharpa hanria.

The genera which I find represented in largest numbers in Sikkim, and which are most abundant in species also, are the following:—

Lethe, with 23 species, a genus well-represented nowhere but in Himalaya.
Zophoessa, with 9 species; only one or two known elsewhere.
Neptis, with 17 species; very numerous in the Indo-Malay countries.
Euthalia, with 15 species.
Charaxes, with 10 species.
Amblypodia, with 21 species.

Papilio, with 42 species.
Parnara, with 10 species.
Halpe, with 7 species.

When we come to examine the list of species, I find that there are:—Common to the three lists about 63; common to Sikkim and Malayana, 120; common to Sikkim and the North-west Himalaya, 220.

Species hitherto only found in Sikkim about 70, of which many no doubt occur in Nepal and Bhutan, and possibly in the Khasia Hills.

It is sometimes as important to compare the genera which are absent as well as those which are present in a fauna, and with this object I have drawn up the following list:—

Genera and Number of Species in Genus.

Genera occurring in Sikkim, but not in Malay Peninsula.	Occurring in Malay Peninsula, but not Sikkim.	In Sikkim, but not in North-west Himalaya.	In North-west Himalaya, but not in Sikkim.
Anadebis, 1	Hestia, 3	Anadebis, 1	Pararge, 3
Zophoessa, 9	Idæopsis, 1	Discophora, 3	Epinephele, 4
Neope, 2	Cælites, 2	Enispe, 2	Erebia, 2
Orinoma, 1	Erites, 1	Thaumantis, 1	Dilipa, 1
Raphicera, 2	Ragadia, 1	Stictopthalma, 2	Azanus, 2
Satyrus, 4	Zeuxidia, 3	Clerome, 1	Polyommatus, 3
Œneis, 1	Temaris, 1	Ergolis, 2	Remelana, 1
Callerebia, 1	Xanthotænia, 1	Cethosia, 2	Hydsura, 1
Enispe, 2	Rhinopalpa, 2	Cynthia, 2	Gonepteryx, 2
Stictopthalma, 2	Prothoe, 3	Helcyra, 1	Anthocharis, 1
Pareba, 1	Tanæcia, 8	Herona, 1	Syricthus, 1
Telchinia, 1	Parthenos, 1	Cirrochroa, 2	Spilothyrus, 1
Melitæa, 1	Terinos, 2	Lebadea, 1	Lobocla, 1
Helcyra, 1	Simiskina, 1	Doleschallia, 1	
Sephisa, 1	Stiboges, 1 (found in Bhutan)	Zemeros, 1	13 genera containing 23 species.
Apatura, 5		Loxura, 1	
Herona, 1	Parageryduis, 2	Gerydus, 1	
Stibochiona, 1	Deramas, 1	Liphyra, 1	
Argynnis, 6	Drupadia, 1	Spalgis, 1	
Dichorragia, 1	Biduanda, 2	Jamides, 1	
Calinaga, 1	Semanga, 1	Lycænesthes, 3	
Dodona, 5	Neocheritra, 2	Bindahara, 1	
Spalgis, 1	Sinthusa, 2	Camena, 1	
Iolaus, 3	Neomyrina, 1	Cheritrella, 1	
Camena, 1	Purlisa, 1	Sithon, 3	
Virachola, 1	Jacoona, 1	Iolaus, 3	
Pratapa, 1	Panchala, 5	Pontia, 1	
Ilerda, 4	Udaiana, 1	Prioneris, 2	
Thecla, 2	Saletara, 2	Dercas, 2	
Colias, 1	Leptocircus, 2	Hebomoia, 1	
Pieris, 6	Unkana, 3	Teinopalpus, 1	
Tachyris, 1	Lotongus, 2	Ornithoptera, 2	
Teinopalpus, 1	Paduka, 1	Pirdana, 1	

Genera occurring in Sikkim, but not in Malay Peninsula.	Occurring in Malay Peninsula, but not Sikkim.	In Sikkim, but not in North-west Himalaya.	In North-west Himalaya, but not in Sikkim.
Parnassius, 3	Zea, 1	Hasora, 2	
? Badamia, 1	Isma, 3	Bibasis, 1	
Bibasis, 1	(? Halpe in part)	Matapa, 4	
Capila, 1	Hidari, 3	Capila, 1	
Pizzola, 1	Casyapa, 1	Pizzola, 1	
Suastus, 3	Kerana, 1	Pithauria, 2	
Sarangesa, 1		Baoris, 1	
Pamphila ?, 2	37 genera containing 70 species.	Pterygospidea, 1	
Thanaos, 3		Astictopterus, 1	
Cyclopides, 1		Barachus, 1	
Halpe, 7			
Taractocera, 1		43 genera containing 65 species.	
Isoteinon, 7			
Dharpa, 1			
Chaticneme, 1			
Barachus, 1			
49 genera containing 107 species.			

This list proves very conclusively how great is the richness of the Sikkim butterfly fauna as compared with that of the adjoining countries, for we find both in the case of the Malay Peninsula and the North-west Himalaya that the number of genera and species found in Sikkim, but wanting in these countries, is much greater than the number which they possess, but which are wanting in Sikkim.

On the whole we may say that there is probably no place of so small an area in the Old World, and probably very few in the New, which can rival Sikkim in the variety and interest of its Rhopalocera, and probably this will apply to the Heterocera also.

In the following catalogue I have endeavoured to avoid all unnecessary references, believing that these are out of place, except in a systematic work. I have cited Marshall and de Nicéville's 'Butterflies of India' shortly as "Butt. Ind.," the 'Proceedings' of the Zoological Society as "P. Z. S.," the 'Journal' of the Asiatic Society of Bengal as "J. A. S. B.," with the year of publication, but not the number of the volume.

With regard to the species described by old authors, such as Linnæus, Cramer, Fabricius, &c., I believe that it is now often impossible to be certain as to the origin

of the specimens they described and figured, and where, as frequently happens in the commoner and wider-ranging species, local varieties have been specifically separated from the supposed typical form, confusion and inaccuracy must often result from an attempt to restrict the old name to one or other of them. Fixity and uniformity of nomenclature is in my opinion more important than an extreme regard for priority, which cannot always be ascertained with certainty. I care but little what name is used for a species so long as every one uses the same name for the same thing, and have, therefore, in one or two cases refused to follow changes in nomenclature proposed by other writers.

NYMPHALIDÆ.

DANAINÆ.

1. *Danais melanoides.*

Parantica melanoides, Moore, P.Z.S., 1883, p. 247.
Danais aglea (part) auctorum, Butt. Ind., i., p. 38, t. vi., 7, ♂ ♀ (1882).

Common in the Terai and up to 5—6000 ft. from March to December. If Moore is right, as I believe he is, in identifying Cramer's *D. aglea* with the South Indian species known as *ceylonica*, Feld., the Himalayan form, which extends to Tenasserim and Formosa, must bear the name of *melanoides*.

2. *Danais tytia.*

Danais tytia, Gray, Lep. Nep., p. 9, t. ix., 2 (1846); Butt. Ind. i., p. 42.
D. sita, Koll., Hugel's Kash., p. 424, t. vi. (1848).

Occurs from the lowest valleys up to 8—9000 ft., but most abundant at 2—3000 ft. between March and December. It was not so common in 1886 in Sikkim as in the Khasias, where it is abundant on the plateau, but according to de Nicéville it is much more numerous in some seasons than others.

3. *Danais melaneus.*

Papilio melaneus, Cram., Pap. Ex., t. xxx., D (1775).
Danais melaneus, Butt. Ind., i., p. 43, t. v., 5, ♂ ♀.

Common in the low valleys and found up to about 6000 ft. from March to December.

4. *Danais limniace.*

Papilio limniace, Cram., Pap. Ex., i., t. lix., D, E (1775).
Danais limniace, Butt. Ind., i., p. 47.

Not common in Sikkim, but occurs in the Terai and lowest valleys.

5. *Danais septentrionis.*

Danais septentrionis, Butl., Ent. Mo. Mag., xi., p. 163 (1874); Butt. Ind., i., p. 48.

Commoner than the last, and occurs up to about 5000 ft. from April to December.

6. *Danais chrysippus.*

Papilio chrysippus, Linn., Mus. Ulr., p. 263 (1764).
Danais chrysippus, Butt. Ind , i., p. 50.

Not so common as in dryer districts, but occurs up to about 8000 ft. in most months of the year.

7. *Danais genutia.*

Papilio genutia, Cram., Pap. Ex., t. ccvi., C, D (1779).
Danais genutia, Butt. Ind., i., p. 52.
D. plexippus, auctorum (nec Linn.).

Common up to about 5000 ft. during the whole year.

8. *Euplœa* (*Salpinx*) *rogenhoferi.*

Euplœa rogenhoferi, Feld., Reise Nov., ii., p. 325 (1865), ♂; Butt. Ind., i., p. 60.

Occurs, but not abundantly, in the hottest valleys at 1—2000 ft. from April to November.

9. *Euplœa* (*Pademma*) *Klugi.*

Euplœa Klugii, Cat. E. I. C., p. 130, ♂ ♀ (1857); Butt. Ind., i., p. 64.

Pademma Klugi, Moore, P.Z.S., 1883, p. 305, t. xxxii., 1 ♂.

A very rare species, which, according to Möller, occurs in the hills only, while the next is confined to the Terai; but I am not satisfied that he has correctly identified the insect described and figured by Moore, which, according to Marshall and de Nicéville, occurs in Bhotan and the Assam hills, but of which I have seen no example from Sikkim.

10. *Euplæa* (*Pademma*) *Kollari.*

Euplæa Kollari, Feld., Reise Nov., ii., p. 325 ♂ (1867).
Pademma Kollari, Moore, P.Z.S., 1883, p. 309, t. xxix., fig. 9, ♂.
Euplæa sinhala, Butt. Ind., p. 66, t. vii., 12, ♂ ♀ (1882).

This species, which is not uncommon at Calcutta, occurs, but not commonly, in the Terai, and I have a specimen which I believe to be from the Tista Valley agreeing with Calcutta examples.

11. *Euplæa* (*Danisepa*) *rhadamanthus.*

Papilio Rhadamanthus, Fab., Ent. Syst., iii, p. 42 (1783).
Euplæa (*Salpinx*) *rhadamanthus*, Butt. Ind., p. 69, t. vii., 11, ♂ ♀.

A common species here as elsewhere up to about 3000 ft. from April to December.

12. *Euplæa* (*Trepsichrois*) *midamus.*

Papilio midamus (part), Linn., Mus. Ulr., p. 251 (1764).
Euplæa midamus, Marsh. and de Nicé., Butt. Ind., i., p. 74, t. viii., fig. 13, ♂ ♀ (et auctorum).
Trepsichrois linnæi, Moore, P.Z.S., 1883, p. 286, t. xxix., 4, ♀, t. xxx., 1, ♂.

Common up to 6 or 7000 ft. from April to December. I have not followed Moore in changing the name of this very well-known species, because there seems to be no doubt that Linnæus knew and described this insect; and though, in his description, he may have mixed up

another well-known species from South China with the form to which Moore now restricts the name *midamus*, yet I doubt whether any one but Mr. Moore would distinguish his supposed *E. midamus*, Linn., from *E. superba*, Herbst., which, in his monograph of the genus, he cuts up into three or four species. Unless we are prepared to recognise these as distinct, we should, though in doubt as to which of them Linnæus intended to describe, then have to change two well-known names, and bring confusion into what was previously clear.

13. *Euplæa core.*

Papilio core, Cram., Pap. Ex., t. ccxxvi., E, F (1780).
Euplæa core, Butt. Ind., i., p. 80, t. ix., 16, ♂ ♀.
Crastia core, Moore, P.Z.S., 1883, p. 277, t. xxix., fig. 8, ♂.

Fairly common at low levels during the whole year.

14. *Euplæa deione.*

Euplæa deione, West., Cat. Or. Ent., p. 76, t. xxx., vii., 3 (1848), ♂; Butt. Ind., i., p. 88.
E. pocyi, Feld., Reise Nov., ii., p. 340 (1867), ♀.

Not a very rare insect in the low valleys from May to October, but the female is seldom taken.

15. *Euplæa alcathoe.*

Euplæa alcathoe, Godt., Enc. Meth., ix., p. 178 (1819); Butt. Ind., i., p. 86, t. ix., fig. 17, ♂ 9.

Said by de Nicéville to occur not uncommonly in Sikkim and Sylhet, but I have seen no specimens from Sikkim.

16. *Euplæa (Stictoplæa) hopei.*

Euplæa hopei, Feld., Reise Nov., ii., p. 328 (1865); Butt. Ind., i., p. 92, t. ix., 18, ♂ ♀.
E. binotata, Butl., J. L. S., Zool., xiv., p. 302 (1878); Butt. Ind., i., p. 93.
Stictoplæa binotata, Moore, P. Z. S., 1883, p. 319, t. xxx., fig. 4, ♂.

Found not uncommonly up to about 3000 ft. from April to October. I am convinced that the supposed differences between *hopei* and *binotata*, relied on by Moore

and Butler, are not constant. In a series of nine males and three females from Sikkim, in my collection, the supposed characters of both these, and of *S. regina* as well, are shown to be inconstant, as appears to be the case in a very large proportion of Moore's species.

SATYRINÆ.

17. *Anadebis himachala.*

Mycalesis ? himachala, Moore, Cat. E. I. C., i., p. 234 (1857).

Anadebis himachala, Butl., Ann. Nat Hist., 1867, p. 51, t. ii., 1; Butt. Ind., i., p. 99, t. xiv., 35, ♀.

Not uncommon up to about 4000 ft. from April to October.

18. *Mycalesis blasius.*

Papilio blasius, Fabr., Ent. Syst., Supp., p. 426 (1798).

Calysisme blasius, Moore, Trans. Ent. Soc. Lond., 1880, p. 162.

Mycalesis blasius, Butl., P. Z. S., 1867, p. 720; Butt. Ind., i., p. 115, t. xvi., fig. 55, ♂.

*Gen. *hyemale* (*fide* de Nicéville), *perseus*.

Papilio perseus, Fabr., Syst. Ent., p. 488 (1775).

Mycalesis perseus, Butt. Ind., i., p. 120.

M. perseus et *blasius*, de Nicé., J. A. S. B., 1886, p. 235.

These insects, which have been proved by Mr. de Nicéville in Calcutta to be seasonal forms of each other, are not common in the Sikkim hills, but occur at low elevations, and more abundantly in the Terai. I am not able to say whether they are here confined in their seasons of appearance to the same months as in Calcutta, but Möller notes them both as occurring towards the end of the rains in September and October.

19. *Mycalesis medus.*

Papilio medus, Fab., Syst. Ent., p. 488 (1775); Butt. Ind , p. 111.

? Gen. *hyemale*, *Mycalesis runeka*, Moore, Cat. Lep. E. I. C., p. 234 (1857); de Nicé., Butt. Ind., p. 112, t. xvi., fig. 56.

* I use the word *hyemale* here to distinguish the dry-season form, that being, though hot, the winter of India.

This wide-ranging species is not common in Sikkim, but occurs in the Terai and up to 3000 ft. *Medus* is the rainy season form, which occurs from May to September, and *runeka* from October to March, though, as I said in speaking of the last species, there may be occasional instances of either forms being taken out of season. *M. runeka* seems more abundant than *medus*, which is rather an insect of the plains than the hills.

20. *Mycalesis mineus.*

Papilio mineus, Linn., Syst. Nat., i., pt. 2, p. 768 (1767).
Mycalesis mineus, Butt. Ind., i., p. 117.
M. visala, Moore, Cat. E. I. C., i., p. 230 (1877).
M. perseus var. *visala*, Butt. Ind., i., p. 121, t. xvi., fig. 52, ♂.
Calysisme indistans, Moore, Trans. Ent. Soc. Lond., 1880, p. 164.
Mycalesis perseus var. *indistans*, Butt. Ind., i., p. 122.
M. mineus, visala et *indistans*, de Nicé., J. A. S. B., 1886, p. 235.

Mr. de Nicéville's recent experiments in breeding have thrown some light on the seasonal forms of this difficult species in Calcutta, but I cannot say to what extent his conclusions are borne out in the different climate of Sikkim. Möller, however, has little doubt that *M. visala* is the dry-weather form, and finds it commonly from the Terai up to about 5000 ft., at the end of the rains and on to December. *Mineus* he takes at the same elevations from April to September, and he does not distinguish *indistans* from it at all. I hardly think that the various broods will prove to be constantly distinguishable from each other, except in localities where the seasons are better marked than in Sikkim.

21. *Mycalesis anaxias.*

Mycalesis anaxias, Hew., Ex. Butt., iii., *Myc.*, t. iv., figs. 25, 26 (1862), ♂; Butt. Ind., p. 106, t. xvii., fig. 54, ♂.

Not uncommon in the hot valleys up to 3000 ft. during the greater part of the year.

22. *Mycalesis sanatana.*

Mycalesis sanatana, Moore, Cat. Lep. E. I. C., p. 231 (1857); Butt. Ind., p. 108.

? Gen. ii. *M. gopa*, Feld., Reise Nov., iii., p. 501 (1867); Butt. Ind., p. 107.

In placing *M. gopa* as probably the second or rainy season brood of *M. sanatana* I rely on the opinion of Messrs. de Nicéville, Möller, and Knyvett, and, though occasional specimens of the one may be found during part of the season of the other, all these gentlemen, who know the species well in life, agree that *sanatana* is the prevailing, if not the only, form during the months of March, April, and May, and that *gopa* prevails during the months of June to October. The observations of Mr. de Nicéville on the seasonal forms of *Mycalesis* and other genera of *Satyrinæ* in Calcutta all tend to strengthen the belief that most of the species of *Mycalesis*, *Yphthima*, and *Melanitis* have two forms differing principally in the ocelli and markings of the under side, and he concurs with Mr. Möller in the propriety of the arrangement which I have adopted in this catalogue. It is quite possible that in some cases we may be mistaken, and that different seasonal and climatic influences may in other localities produce different effects; but those who disbelieve in the seasonal variation, which is well known to exist in some European and American butterflies, must allow that the causes which produce them are experienced to a much greater degree in the climate of India, which is marked by an even greater difference between the wet and dry seasons of the year than is found between the climate of spring and summer in temperate countries. Both these forms occur not uncommonly in the valleys of Sikkim up to about 3000 ft. *M. gopa* has not been found except in Sikkim, according to de Nicéville, but it is very nearly allied to, and perhaps hardly distinct from, *M. perdiccas*, Hew., from Japan. Möller has several specimens of *M. sanatana* with partially-developed ocelli intermediate between it and *gopa*.

23. *Mycalesis suaveolens.*

Mycalesis suaveolens, W. M. and de Nicé., Butt. Ind., p. 125; W. M. and de Nicé., J. A. S. B., 1886, p. 349, t. xvi., fig. 1, ♂.

This species, described from a single specimen taken at Nemotha, in Cachar, occurs very locally in Sikkim. Möller has taken it in April and May only in one place at about 3000 ft. below Tukvar. The female is like the male, but larger, with rather larger ocelli.

24. *Mycalesis malsara.*

Mycalesis malsara, Moore, Cat. Lep. E. I. C., p. 231 (1857); Butt. Ind., p. 129.
? Gen. i. *hyemalis*, *M. rudis*, Moore, Trans. Ent. Soc. Lond., 1880, p. 166.

A common species in Sikkim from the Terai up to 3000 ft. It occurs from March to November in the form of *malsara*, but the form known as *rudis*, which Messrs. Möller and Knyvett both think is its cold-weather brood, is only taken in February, March, and April.

The insect described as *M. Lepcha*, Moore (Trans. Ent. Soc. Lond., 1880, p. 167, from Nepal), and which, according to de Nicéville, occurs also at Mussoorie in May at 7000 ft., is perhaps another form of this species, but there is great difficulty in deciding, on our present limited knowledge, how to classify the very variable insects of the genus *Mycalesis*.

25. *Mycalesis nicotia.* (Pl. IX., fig. 5, ♀).

Mycalesis nicotia, Hew., Gen. D. L., p. 394, t. lxvi., fig. 4 (1851), ♀; Ex. Butt., iii., *Myc.*, t. i., fig. 1, ♂; Butt. Ind., p. 129.
M. Langi, de Nicé., Butt. Ind., i., p. 130.

According to Möller this is a distinct species, though allied to *M. nicotia*. It has a less ocellated form, which occurs in spring in the same localities as *nicotia* at 2—5000 ft., and another strongly ocellated brood which comes out in May and August. I have figured a female of this form taken by Möller on May 3rd. Having examined the types of *nicotia*, I am inclined to think that, even if *Langi* can be separated, the specimens in the

Hewitson collection include both forms, and I do not at present see my way to distinguish them. *Nicotia*, according to Möller, is rare, and occurs in the spring months only.

26. *Neorina margaritæ.*

Lethe? margaritæ, Elwes, P. Z. S., 1882, p. 405, t. xxv., 1, ♂.

Neorina margaritæ, Butt. Ind., p. 136.

I am as yet uncertain whether this beautiful species occurs in Sikkim or not, as my first specimen was brought by native collectors from some place to the eastward of the Tista river; but Mr. Knyvett's collectors have lately taken others of both sexes near Buxa, in Bhotan, and I have no doubt it occurs near to, if not within, British Bhotan, probably at the same elevation as *N. hilda*. The female does not differ except in having a rather broader band on the fore wing.

27. *Neorina hilda.*

Neorina hilda, Westw., Gen. Di. Lep., p. 370, t. lxv., 2 (1851), ♂; Butt. Ind., i., p. 134.

This lovely insect is one of those most characteristic of the dark gloomy oak and chestnut forests of the Eastern Himalayas, and occurs from the end of June till September at 7—9000 ft. It flies up and down the paths in dense forests, and settles on the ground or on tree-trunks, when it is not so conspicuous as it is on the wing. The female is either much rarer or more seldom seen than the male; but I once saw one flying rapidly over the bare open top of the observatory-hill at Jellapahar, which is a very favourite place for the females of many forest-loving butterflies to fly on sunny mornings in the rainy season, and, after a stiff race with a burly bombardier from the depôt, who was a regular collector on this spot, I netted the prize. I found the species much commoner to the eastward in British Bhotan than in Sikkim, which is the most western locality we know for this species.

The numerous species of *Lethe* which inhabit the dense forests of the Eastern Himalayas, and which are very characteristic of this region, are difficult to under-

stand and discriminate without perfectly fresh specimens of both sexes; but, as my collection now contains very fine series of almost all of them, I will give a *résumé* of their characters and distribution, which may be useful to those who are not so well off, and which, though much shorter than that given in the 'Butterflies of India,' will, I think, be found correct:—

Group I. *Males with patches of raised scales on the fore wing above, below the median nervure.*

a. Males with a conspicuous patch of hairs on the hind wing above.

1. *L. scanda.* Male deep indigo-blue; female dark brown. Sikkim, 6—9000 ft.
2. *L. bhairava.* Male and female dark brown, the latter with a transverse band of white spots on fore wing above. Sikkim, 6000 ft., and West Bhotan.
3. *L. gulnihal,* de Nicé. Inner margin of fore wing concave. Bhotan.
4. *L. Latiaris.* Male and female pale brown, the latter with faint fulvous band on middle of costa and across fore wing. Sikkim, 4—5000 ft. through Assam hills to Tenasserim.

b. With tufts of hairs on hind wing between first and second median nervules.

5. *L. minerva,* Fab. (*arcadia,* Cram.). Tenasserim; Sumatra; Java.

c. With three small patches on median nervule.

6. *L. tristigmata,* Elwes. Sikkim, 8—10,000 ft.

Group II. *Males without sexual glands or tufts.*

a. With fore wing long and narrowed at the apex; hind wing with well-marked tail.

7. *L. sinorix.* Males with three white spots across fore wing above, and rufous band on hind wing. Sikkim (rare), through Bhotan to Upper Assam (Sibsagor District).
8. *L. kansa.* Male pale brown, without white spots or rufous band. Sikkim, 2—3000 ft., through Assam to Tenasserim.

9. *L. vindhya*, Feld. (*alberta*, Butl.), ♂; ? *L. purana*, Feld. (*dolopes*, Hew.), ♀. Male and female dark brown above, with dark transverse bands bordered lilac below.

b. With fore wing broader and less elongate, the outer margin more or less concave, tails less defined. Females with transverse irregular white band on fore wing above.

10. *L. mekara*. Male with narrow rufous band on hind wing above. Sikkim, 2—5000 ft., to Tenasserim.
11. *L. distans*, Butl. Male with broad rufous band on hind wing above. Sikkim to West Bhotan.
12. *L. chandica*, Moore. Male very dark brown, with no rufous band.

c. With broad fore wing. Females with transverse regular white band.

13. *L. europa*, Fab. Male and female paler brown; no white spot on costa. Sikkim Terai, all over India, and Malayana.
14. *L. dyrta*, Feld. Smaller; male with whitish spot on costa.

d. With fore wing not concave. Females with transverse regular white band.

15. *L. hyrania*, Koll. Beneath dull brown, without lilac gloss; transverse band on fore wing below straight. N.W. Himalaya, 9000 ft.
16. *L. davidis*, Ob. Transverse band on fore wing below angled outwardly. East Tibet.
17. *L. dinarbas*, Hew. Glossed with lilac below; discoidal band on fore wing beneath broader. Sikkim; West Bhotan.
18. *L. brissandra*, de Nicé. Glossed with lilac beneath; discoidal band narrower. West Bhotan.

e. Both sexes with a white band across the fore wing.

19. *L. rohria*, Fab. With white spots at apex of fore wing above. N.W. Himalaya, through Assam and Tenasserim to Java and China.
20. *L. masoni*, Elwes. White band broad, and hind wing bordered with white. N.W. Bhotan.

21. *L. episcopalis*, Ob. White band narrow and fore wing inwardly rufous beneath. East Tibet.
22. *L. verma*, Koll. No apical white spot. Kashmir to Tenasserim.

Group III. *Males without sexual glands or tufts. Sexes not differing conspicuously; of a deep glossy brown.*

23. *L. serbonis*, Hew. Larger, without lilac lunules or bands beneath. Sikkim, 7—9000 ft.
24. *L. sidonis*. Ocelli of hind wing beneath not blurred; deep brown above. N.W. Himalayas to Sikkim and Khasia hills.
25. *L. nicetella*, de Nicé. Ocelli of hind wing not blurred; smaller, golden brown above. Sikkim, 7—9000 ft.
26. *L. siderea*, Marsh. Like *sidonis*, but smaller beneath; markings duller, and no transverse bands on fore wing. Sikkim, 7—8000 ft.
27. *L. nicetas*, Hew. Fore wings more pointed and narrower; ocelli of hind wing distinct above. N.W. Himalaya to Sikkim.
28. *L. maitrya*, de Nicé. Ocelli blurred below, indistinct above; costal and apical bar in male hardly perceptible. N.W. Himalaya to Sikkim, 9—12,000 ft.
29. *L. armandia*, Ober. Ocelli blurred below, distinct above; costal and apical bars distinct. Moupin, E. Tibet.
30. *L. visrava*, Moore, ♂. Sexes? very distinct. Male hind wing with a white marginal band. *L. deliades*, Hew., ♀. Female white, with rufous markings. Sikkim; W. Bhotan.

Besides these there are several species in Ceylon and Southern India, and several more in China and Japan, as well as one in the North-west Himalaya, *L. vaivarta*, Doherty, which is very near to *sidonis*, and one in Assam, *L. satyavati*, de Nicéville, of which the female only is known, and which I cannot classify; but Sikkim is evidently the metropolis of the genus, as no less than 23—or, if *deliades* is not the female of *visrava*, as I believe, 24—species, all quite distinct from each other, occur there, more than twice as many as are found in any other locality.

My arrangement differs in some respects from that of Mr. de Nicéville, as I doubt whether his third group is a natural one, and, though it is very difficult to describe the characters by which some of the species of the *sidonis* group are separated, yet I find but little variation in any of the species except *sidonis*, of which the north-western form might well be separated from that found in the Khasia hills, if there were no intermediate links.

I never found any of the most nearly-allied forms, such as *nicetas*, *sidonis*, *nicetella*, and *maitrya*, under circumstances which would lead me to suppose they interbreed: in all except the first, the females are very seldom seen. Out of hundreds of *nicetella*, *maitrya*, and *sidonis*, which I took myself, I only have one female of each of the two first, and five of *sidonis*; of *siderea* I never took either sex, and I think the female is unknown, as is also the case with *tristigmata*.

28. *Lethe scanda.*

Lethe scanda, Moore, Cat. Lep. E. I. C., i., p. 218 (1857), ♂; Butt. Ind., i., p. 139.
Debis nada, Moore, *l. c.*, p. 218, ♀.
Zophoessa dirphia, Druce, Cist. Ent., i., p. 357 (1875), ♀; Butt. Ind., i., p. 168.

This species is not uncommon in the dense virgin forest on Tendong and near Rikisum, and rarer on the flanks of Sinchul from 6 to 8000 ft., in the months of July and August. I have, however, taken a single female in the end of June, but this sex is always rare, and flies but little. Having seen the type of *Z. dirphia*, I can say that it is identical with *scanda*. The species has not been found except in Sikkim and British Bhotan.

29. *Lethe bhairava.*

Lethe bhairava, Moore, Cat. Lep. E. I. C., p. 217 (1857), ♀; Butt. Ind., i., p. 139.
Debis anysis, Hew., Ex. Butt., vol. iii., *Debis*, t. i., fig. 1 (1862), ♂.

A rare insect in Sikkim, which I have only taken at the Rangbi Bridge in May, and on the flanks of Dhumsong, in British Bhotan, at 6000 ft., in August. Möller's shikaris have taken it in June, and near Buxa, in Bhotan,

at 5000 ft., in June. I have seen Hewitson's type of *anysis*, which cannot be separated from *bhairava*, but the insect which is placed in the British Museum as the female of *anysis*, which is there kept separate from *bhairava*, is *L. scanda*.

30. *Lethe latiaris*.

Debis latiaris, Hew., Ex. Butt., vol. iii , *Debis*, t. i., fig. 4 (1862), ♀.
Lethe latiaris, Butl., Cat. B. M., *Satyridæ*, p. 117 (1868); Butt. Ind., i., p. 140.

A rare or local species in Sikkim, but, according to Moller, found in April and May, and again in October, at 2—5000 ft. on the Tukvar spur. My shikaris brought a single female from the interior in 1883, which must, I think, have been taken at a higher elevation. The male has a conspicuous patch of hairs on the centre of the hind wing.

31. *Lethe sinorix*.

Debis sinorix, Hew., Ex. Butt., vol. iii., *Debis*, t. iii., figs. 19, 20 (1863), ♂.
Lethe sinorix, Butt. Ind., p. 144.

This must be a very rare species in Sikkim, as I have only one old specimen from Wilson's collection, and Moller has only one, which differs from Bhotan specimens in wanting the rufous margin of the hind wing. It occurs, however, more commonly near Buxa, where Mr. Knyvett's collectors have taken both sexes in July and August. The female, which is undescribed, differs from the male in having a transverse band showing through on the fore wing above. It is also paler in colour than the male. I took it at Cherra Punji in the Khasia hills, in September.

32. *Lethe Kansa*.

Debis Kansa, Moore, Cat. Lep. E. I. C., p. 220 (1857).
Lethe Kansa, Butt. Ind., p. 145.

A fairly common species at 2—4000 ft., and taken up to 9000 ft. between April and October. Moore's description of this species is bad and can hardly be recognised, but I have seen the type. De Nicéville's description of both sexes is good, but a figure is wanted.

33. *Lethe vindhya.*

Debis vindhya, Feld., Wien. Ent. Mon., vol. iii., p. 402 (1859), ♂.

Lethe vindhya, Butt. Ind., i., p. 146.

L. alberta, Butl., Ann. Nat. Hist., 1871, p. 283 ; Lep. Ex., p. 87, t. xxxiii., fig. 5 (1872), ♂ ; Butt. Ind., i., p. 147.

? *Debis purana*, Feld., Wien. Ent. Mon., vol. iii., p. 401 (1859), ? ♀.

Lethe purana, Feld., Butt. Ind., i., p. 146.

L. dolopes, Hew., Ent. Mo. Mag., ix., p. 85 (1872), ♀ ; Butt. Ind., i., p. 147.

I have little doubt that the four names quoted above are all synonymous of one species, though, without seeing Felder's type, it is impossible to be certain. At any rate, we have only one species in Sikkim which can be made to fit any of them, and I have compared this with the types of *alberta* and *dolopes* in the British Museum. It is very rare in Sikkim and in Bhotan and in the Khasia hills. Mr. Gammie took a single female close to his house at 3800 ft. in the month of August; Messrs. Knyvett and Möller's native collectors took two or three specimens near Buxa, in Bhotan ; and I took a single male myself near Cherra Punji in the Khasia hills, at the end of September, at about 2500 ft.

34. *Lethe mekara.*

Debis mekara, Moore, Cat. Lep. E. I. C., p. 219 (1857); Butt. Ind., p. 148, t. xi., fig. 24, ♂ ♀.

A common species in the low valleys, and up to 5000 ft., from March to November. It frequents bamboos, and when disturbed flies into the thick foliage, where it settles on a bamboo-stem with closed wings, and is difficult to see. Like several of its congeners, it prefers shady to sunny places.

35. *Lethe distans.*

Lethe distans, Butl., Trans. Ent. Soc. Lond., 1870, p. 488 ; Lep. Ex., p. 87, t. xxxiii., fig. 4, 6 ♂, 7 ♀ (1872).

I know nothing of this species in Sikkim, but two

specimens in the British Museum, said to be from Darjeeling, differ from *mekara* in having a broader and more rufous band on the margin of hind wing above, and the male has five ocelli, whilst five male specimens of *mekara* in my collection only have four. The markings of the under side also are more irregular, as in *L. chandica*, to which this species is perhaps more nearly allied. The figures in 'Lepidoptera Exotica' are not well coloured. There are two females in Moore's collection which come nearer to *mekara*, and Mr. Knyvett has procured a pair from Buxa.

36. *Lethe chandica.*

Debis chandica, Moore, Cat. Lep. E. I. C., p. 219 (1857).
Lethe chandica, Butt. Ind., p. 149.

Common at the same elevation and in the same months as *D. mekara*, and has very similar habits.

37. *Lethe Europa.*

Papilio Europa, Fab., Syst. Ent., p. 500 (1775).
Lethe Europa, Butt. Ind., p. 149.

This is not a common butterfly in Sikkim, as Mr. de Nicéville thinks, but he has taken it in October. It is probably rather an inhabitant of the plains, and only a straggler in the low valleys of Sikkim.

38. *Lethe dyrta.*

Debis dyrta, Feld., Reise Nov., vol. iii., p. 497 (1867).
Lethe dyrta, Butt. Ind., i., p. 152. t. x., fig. 22, ♂ ♀.

Not a common species in Sikkim, but found almost throughout the year at elevations up to 3 or 4000 ft.

39. *Lethe dinarbas.*

Debis dinarbas, Hew., Ex. Butt., iii.; *Debis*, t. iii., fig. 15 (1863), ♂.
Lethe dinarbas, de Nicé., Butt. Ind., p. 155; J. A. S. B., 1886, p. 250, t. xi., fig. 4, ♀.

Not uncommon in the virgin forest from 7 to 8 or 9000 ft. between the months of June and November. The female is rare, and resembles that of the very

nearly allied species or form *L. hyrania*, Koll., which replaces *dinarbas* in the North-west Himalaya. Hewitson's type-specimens, which are perhaps faded, show but little difference between the two, but in fresh Sikkim specimens the ground colour of the under side is much deeper, and the pattern and ocelli more strongly marked than in *hyrania*. *Lethe brissanda*, de Nicéville, is a nearly allied species found with *dinarbas* at Buxa, and *Debis Davidis*, Oberthür, which is also a close ally, represents it in Eastern Tibet.

40. *Lethe rohria.*

Papilio rohria, Fab., Mant. Ins., ii., p. 45 (1787).
Lethe rohria, Butt. Ind., p. 156.

Common in the low valleys up to 5000 ft. from April till November.

41. *Lethe verma.*

Satyrus verma, Koll., Hügel's Kash., iv., p. 447, t. xvi. (1848).
Tansima verma, Moore, P. Z. S., 1882, p. 235.
Lethe verma, Butt. Ind., p. 158, t. x., fig. 23, ♂.

Not uncommon up to 8000 ft. between April and November, but commonest at about 4000 ft. in the rains.

42. *Lethe Masoni.*

Debis Masoni, Elwes, P. Z. S., 1882, p. 405, t. xxv., fig. 2.
Lethe Masoni, Butt. Ind., p. 159.

This species has as yet only been found in the interior to the eastward by my native collectors, probably in Bhotan or the Chumbi valley. *Debis episcopalis*, Oberthür, from East Tibet, is an allied though perfectly distinct species, having the fore wing with a narrow white transverse band above, and the base reddish brown below.

43. *Lethe siderea.* (Pl. IX., fig. 3).

Lethe siderea, Marsh., J. A. S. B., 1880, pt. ii., p. 246; Butt. Ind., p. 159.

This species has hitherto only been found on Tendong, in Native Sikkim, by Möller's collectors at about 7000 ft.

in the rainy season. The female remains unknown. In 1886 it was taken as late as November. All that I have seen are, though very nearly allied to *sidonis*, smaller, and distinguished by the different markings and duller colour of the under side.

44. *Lethe sidonis.*

Debis sidonis, Hew., Ex. Butt., iii.; *Debis*, t. iii., fig. 16 (1862).

Lethe sidonis, Butt. Ind., p. 159.

The commonest species of *Lethe* in the zone of forest from 4 to 8000 ft. between April and November, where it is constantly seen flitting along the forest paths, and settling both on the ground and on low vegetation. The female seems much rarer, and probably flies but little. Sikkim specimens show the markings of the hind wing below of a much more distinct and brilliant violet than those from Mandi in the North-west Himalaya, and are rather smaller and less brilliant than those I took in the Khasia.

45. *Lethe maitrya.*

Lethe maitrya, de Nicé., J. A. S. B., 1880, pt. ii., p. 245; Butt. Ind., t. x., fig. 20, ♂.

Though described quite recently from the North-West, this species is very abundant on Tonglo and along the Singalelah range between Sikkim and Nepal, from 9 to 12,000 ft., in July and August, where it keeps company with *Zophoessa jalaurida*, as in the North-west. I also found it on the Rishilah, in British Bhotan, at 10,000 ft., and my native collectors brought it in great numbers from Bhotan in 1884.

L. maitrya is a forest-haunting insect, and has exactly the same habits as *Zophoessa jalaurida*. The female is very rare, and I have only procured one of the sex, which has the markings of the fore wing more apparent on the upper side than is the case in the male. A male specimen from Moupin, in East Tibet, collected by the Abbé David, and sent me as *L. maitrya*, is clearly a different species.

46. *Lethe serbonis.*

Debis serbonis, Hew., Ent. Mo. Mag., 1876, p. 151; Lep. Coll. Atk., p. 2, t. i., fig. 45 (1879), ♂.

Lethe serbonis, Butt. Ind., i., p. 155.

Not uncommon in the dense virgin forest on Tonglo, Tendong, and Sinchul, from 7 to 9000 ft., in the rainy season between June and September. The female, which is undescribed, has the wings rounder, and the bands and ocelli of the under side show more distinctly on the upper side than in the male.

47. *Lethe nicetella.*

Lethe nicetella, de Nicé., P. Z. S., 1887, p. 448, t. xxxix., fig. 5 ♂.

As a full description of this species is published in the 'Proceedings' of the Zoological Society, I need say no more about it; but I recognised its distinctness from the type of *nicetas* directly I saw it. I found it much commoner than the latter species, the males being abundant along the Goompahar and the flanks of Tonglo from 7 to 8000 ft., or upwards, in July and August. They settle on the roads in wet places on shady paths, but the female is very much rarer, and I only procured a single good specimen, which differs very little from the male.

48. *Lethe nicetas.*

Debis nicetas, Hew., Ex. Butt., vol. iii.; *Debis*, t. iii., 17, 18 (1863), ♀.

Lethe nicetas, Butt. Ind., p. 161.

Though Mr. de Nicéville says that this species is found from 8 to 6000 ft. in the Himalaya, I never found it so low myself; but it was rare in July on the Goompahar ridge near Darjeeling, in virgin forest, at 7 to 8000 ft., and has been taken on Sinchul by Mr. Knyvett in June and August. This species has hitherto been confused with a much commoner one in Sikkim, *L. nicetella*, from which it is, however, quite distinct.

49. *Lethe visrava.*

Debis visrava, Moore, P. Z. S., 1865, p. 768, t. xli., fig. 4, ♂; Butt. Ind., p. 161.

D. deliades, Hew., Ent. Mo. Mag., ix., p. 84 (1872), ♀; Butt. Ind., p. 162.

I think there can be but little doubt that *deliades* is the female of *visrava*; the pattern of both is the same, and only one sex is known of either. It is extremely rare in Sikkim, where Möller procured a single female in June. In Bhotan, however, it is commoner, as Mr. Knyvett's collectors procured several males on June 20th in the hills two or three marches north of Buxa.

50. *Lethe tristigmata.* (Pl. VIII., fig. 1).

Lethe tristigmata, Elwes, P. Z. S., 1887, p. 444.

Mr. Möller and myself both procured this species in 1886, and it had been already described by Mr. de Nicéville; but this gentleman, in order to avoid its being published twice over, gave me permission to use his description. I found the males only in July on the Singalelah range from about 9 to 10,000 ft. elevation in open spots in the dense bamboo thicket. Many of them were then worn, and Moller's native collectors found it fresh in June. The insect is not so gregarious in its habits as some of the other Lethes found with it, and is quite distinct from anything yet known. The female is as yet undiscovered, though we have made numerous attempts to find it at different seasons in the same spots where the males were taken.

51. *Zophoessa sura.*

Zophoessa sura, Doubl. Hew., G. D. L., ii., p. 362, t. lxi; Butt. Ind., i., p. 164.

Not uncommon in the forest from about 8000 ft. from the end of June on until November. The males are seen singly, or in company with other *Satyrinæ*, sitting on the path or low herbage, and if disturbed generally fly up and settle on the trunk of a tree, where they are difficult to distinguish among the dark moss. I took males in June and July on Sinchul: females are rarer and fly but little, though sometimes taken on the bare top of the hill at Sinchul and Jellapahar. I found it also in the Khasia Hills, near Cherra Punji, at 4500 ft., in the end of September.

52. *Zophoessa dura.* (Pl. IX., fig. 1).

Zophoessa dura, Marsh., J. A. S. B., 1882, pt. ii., p. 38, t. iv., fig. 2; Butt. Ind., i., p. 165.

I have two male specimens procured by Mr. Gammie's native collectors somewhere east of the Tista River in 1884 and 1885, which are certainly distinct from *Z. sura,* and agree very closely with the description of *Z. dura.* There are, however, five instead of four spots on the pale border of the hind wing, and it is possible that this species, when compared with the type of *Z. dura* from Tenasserim, will prove distinct. It is, perhaps, hardly to be included in the Sikkim list, but may occur in the forests of the interior, as do many of the species which I have procured from the same source.

53. *Zophoessa goalpara.*

Zophoessa goalpara, Moore, P. Z. S., 1865, p. 768; Butt. Ind., p. 165.

I have not found this myself in Sikkim, but Mr. Möller took it at 6000 ft. in November, and it seems to be commoner than *Z. sura* in the forest at 6—8000 ft. in British Bhutan, where I took it in August near Rikisum. My shikaris brought it from Tendong and from Bhotan, and it occurs as far north-west as Simla. I have not seen the female.

54. *Zophoessa atkinsonia.*

Zophoessa atkinsonia, Hew., Ent. Mo. Mag., 1876, p. 151; Moore, Coll. Atk., p. 2, t. i.; Butt. Ind., p. 166.

I found this species, which has hitherto been very rare in collections, not uncommon on the road to Tonglo at 8—9000 ft. in July; and Mr. Möller's collectors brought numerous specimens from the same locality in August. It also occurs in the interior of Bhotan and Sikkim. It settles on the path and flies into the forest when disturbed. The females are seldom taken, and differ but very slightly from the male.

55. *Zophoessa baladeva.*

Zophoessa baladeva, Moore, P. Z. S., 1865, p. 769, t. xli., fig. 5, ♂; Butt. Ind., p. 167.

I found this species rarer than either of the last on the road up to Tonglo in July, a specimen was taken on the Goompahar in June, and a few others on Tonglo and Tendong in August. It occurs at from about 7 to 9000 ft., and has the same habits as the other Zophoessas. My collectors also brought it from the interior in 1881 and 1883. The female, which is rare, only differs from the male in being larger and paler.

56. *Zophoessa ramadeva.* (Pl. IX., fig. 2).

Zophoessa ramadeva, de Nicé., J. A. S. B., May, 1887.

Of this species, of which I have not yet seen the description, one specimen was procured in August, 1886, from the interior of Sikkim by Moller's collectors. A single male, which was recognised by him as identical is in my collection, and was taken either by myself or by one of my men on Tonglo in July, 1886. It is most nearly allied to *Z. baladeva*, but easily distinguished by the pattern of the under side.

57. *Zophoessa jalaurida.* (Pl. VIII., fig. 4).

Z. jalaurida, de Nicé., J. A. S. B., 1880, pt. ii., p. 245; Butt. Ind., p. 166, t. x., fig. 19.

Though this species was only known from the North-west, where Mr. de Nicéville discovered it on the Jalauri Pass at 6—8000 ft. in 1879, I found it very abundant all along the Singalelah Range between Sikkim and Nepal from 9 to nearly 12,000 ft. in July and August. It is the most abundant butterfly here, and frequents the opener places in the forest, flying quickly in dull and rainy weather, and settling on the paths, where several collect together at any ordure. It settles on bamboo, and also on rocks, where many might be found on wet days and in the evening, and bottled like moths. I also found it on the top of the Rishilah, in British Bhotan, at 10,400 ft., and my shikaris brought it from Chumbi or Bhotan in 1884 and 1885. A large number of specimens hardly vary, and agree with one from the Jalauri

Pass. The female is comparatively scarce, and hardly differs from the male.

58. *Zophoessa mölleri.* (Pl. VIII., fig. 3).

Zophoessa mölleri, Elwes, P. Z. S., 1887, p. 445.

Found by me on the Singalelah Range from about 9 to 11,000 ft. in July, 1886, mixed with *Z. jalaurida*, but not nearly so abundant. The females, of which I took one or two only, are very rare. It is very near to, but quite distinct from, *jalaurida*, as will be seen on comparing the under sides. It has the same habits, and does not appreciably vary in the numerous specimens I collected.

59. *Zophoessa yama.*

Zophoessa yama, Moore, Cat. Lep. E. I. C., i., p. 221 (1857); Butt. Ind., p. 169, t. x., fig. 21.

This species seems rare in British Sikkim, where I never saw it. It occurs on Tendong, however, at 6—7000 ft. in June and July, and to the eastward, where I saw a single specimen at Rikisum in British Bhotan, in August. Mr. Knyvett's collectors also found it commoner near Buxa, in Bhotan. These eastern specimens are much larger and richer in colour than those from the N.W. Himalaya.

60. *Neope pulaha.*

Lasiommata ? pulaha, Moore, Cat. Lep. E. I. C., i., p. 227 (1857).

Neope pulaha, Butt. Ind., p. 170, t. xi., fig. 25.

Not rare on the Singalelah Range at 9—11,000 ft. in July, and common on Tendong and in British Bhotan, near Rikisum, in August. It settles on ordure in the paths, and when disturbed flies quickly into the forest, but returns in a short time to the same place. Mr. Möller also notes its occurrence in March.

61. *Neope bhadra.*

Lasiommata ? bhadra, Moore, *l. c.*, p. 227.

Neope bhadra, Butt. Ind., p. 171.

This species is found in the hot valleys from 1 to 3 or 4000 ft. between May and December. I never saw it in profusion, as Mr. de Nicéville seems to have done, but

only solitary specimens. It settles on the ground as well as on tree-trunks, and if disturbed goes off at once into the forest.

62. *Orinoma damaris.*

Orinoma damaris, Gray, Lep. Nepal, p. 24, t. vii. (1846); Butt. Ind., p. 174, t. xiii., fig. 32.

I never saw this insect myself in Sikkim, but it occurs at 2—4000 ft. (*fide* Möller); and Mr. Gammie tells me that it was abundant in British Bhotan at 6000 ft. in June. At Cherra Punji, in Khasia, I found it common at 4000 ft. on the edge of the forest, and beat it from bushes by the path. Its flight is not strong or quick, but dodging. The female seems rare, but Mr. de Nicéville caught it at 3000 ft. in Sikkim in October. It differs but slightly from the male.

63. *Raphicera satricius.*

Lasiommata satricius, Doubl. Hew., Gen. D. L., p. 387, t. lxiv. (1851).

Raphicera satricius, Butl., Ann. Mag. N. H., 1867, p. 164, t. iv.; Butt. Ind., p. 175.

I found this not uncommon on Sinchul and Tonglo from 6 to about 8000 ft in the end of July and August, and more abundant at 7000 ft. near Rikisum in British Bhotan. It flies quickly with a darting flight about the forest-paths, settling on ordure and wet places, and returning when disturbed. It also settles to rest on damp shady rocks, and flies in wet and cloudy as well as in fine weather. I never saw the female.

64. *Raphicera Moorei.*

Raphicera Moorei, Butl., Ann. Mag. N. H., 1867, p. 164, t. iv,; Butt. Ind., p. 176, t. xv., fig. 38.

This species seems rare in Sikkim, as Mr. Moller had never seen it until I got three specimens on Singalelah at 9—11,000 ft. in July. It occurs higher up than its congener, but seems to have much the same flight and habits. My shikaris brought a few from the interior in 1883 and 1884. The female is rare, but hardly differs from the male.

65. *Satyrus padma.*

Satyrus padma, Koll., Hugel's Kash., p. 445, t. xv., 1, 2 (1848), ♀.
S. avatara, Moore, Cat. E. I. C., p. 229 (1857), ♂.
S. padma, Elwes, Ent. Mo. Mag., 1886.
Aulocera padma, Butt. Ind., p. 196.

When writing of this species recently in the Ent. Mo. Mag. I stated that, though I had specimens from an old Sikkim collection, I was not certain of its occurrence in the Eastern Himalaya. On the 24th June, 1886, I was riding round the north side of Birch Hill on a drizzling afternoon, and saw a male of this species, which had apparently only just emerged from the pupa, settled on a tree by the roadside at about 7000 ft. in a dense sub-tropical virgin forest. This is certainly *padma*, and, like my other supposed Sikkim specimens, is a trifle larger than those from the N.W. Himalaya. It is evidently quite rare in the environs of Darjeeling.

66. *Satyrus loha.* (Pl. IX., fig. 6).

Aulocera loha, Doherty, J. A. S. B., 1886, p. 118.
Satyrus padma, Elwes, P. Z. S., 1882, p. 406.
S. brahminus (in part), Elwes, Ent. Mo. Mag., 1886.

The confusion which I made between this species and *S. brahminus*, in my paper on the Himalayan species of this section of *Satyrus*, is now, I think, cleared up by Mr. Doherty's description, and, though I have only taken male specimens of this species in Sikkim myself, and the smaller ones which I had received from native collectors from Chumbi are very near to *brahminus*, yet I think I am now able to recognise with certainty this species as distinct from both *padma* and *brahminus*.

I took it only on the Singalelah Range which bounds Sikkim on the west between Tonglo and Phallut, at elevations of from 10,000 to 12,500 ft., in July, but it was most abundant on the grassy ridge beyond Sundukpho above the pine-forest, where it flies strongly above the trees, resting on their trunks, and settling on flower-heads in the open parts and on the edge of the forest. The specimens of both sexes from Chumbi are somewhat smaller, and have a narrower band on both

wings than these Singalelah males, resembling *brahminus* very closely.

The male may be distinguished from *padma* by the sexual patch being hardly visible, and by the fact of the two white spots—one on the costa of the fore wing and one between it and the third spot of the band—being always distinctly marked, just as in the female of *padma*.

The female, according to Doherty,—and this is borne out by five females from Chumbi,—is distinguished from *padma* by the band of the hind wing below being narrow, well-defined, and ochreous, whereas in *padma* it is broader; on the outside very ill-defined and whitish.

From *brahminus* it is distinguished, as Doherty says, by the altogether different form of the prehensors and by the rounder shape of the hind wings. On the under side the differences are perceptible, but difficult to describe; but my series, which consists of seven males from Sundukpho, and seven males and five females from Chumbi, when compared with a series of sixteen *brahminus* of both sexes from Chumbi and the North-west, leads me to believe that the differences, though slight, are reliable.

67. *Satyrus brahminus.*

Satyrus brahminus, Blanch., Jacque. Voy., iv., p. 22, t. ii., fig. 4 (1844), ♂ in part.
Aulocera brahminus, Butt. Ind., p. 198, t. xvi., 49 ♂.
Satyrus brahminus, Elwes, Ent. Mo. Mag., 1886.
Aulocera brahminus, Doh., J. A. S. B., 1886, p. 118.

I cannot speak certainly of the occurrence of this species in British Sikkim, but it is common in the interior to the eastward at high elevations. Mr. Doherty says that *A. scylla*, Butl., which, however, he has not seen, is distinct from *brahminus* by the form of the prehensors, though he has taken the two flying together in Kumaon. Whether this is so or not I am only able to say that among my numerous specimens I can find no means of defining more than one species.

68. *Satyrus saraswati.*

Satyrus saraswati, Koll., in Hugel's Kash., p. 445, t. xiv., fig. 34 (1844).
Aulocera saraswati, Butt. Ind., i., p. 200.

I have seen no specimens of this species certainly from Sikkim, but de Nicéville says that such exist in the Indian Museum, and it has been taken by Mr. Knyvett's collectors in the interior of Bhutan; so it may very possibly occur in the drier parts of native Sikkim also.

69. *Ypthima philomela.*

Papilio philomela, Joh. Amæn. Acad., vi., p. 404 (1764); Linn., Syst. Nat., p. 768 (1767).
Ypthima baldus, Fab. Hew., Trans. Ent. Soc. Lond., 1864, p. 286.
Y. philomela, Butt. Ind., i., p. 216; de Nicé., J. A. S. B., 1886, p. 232.
Forma *hyemale*.
Y. marshalli, Butl., Ann. Nat. Hist., 1882, p. 373; Butt. Ind., i., p. 217.

The commonest species of the genus at low elevations in Sikkim from the Terai up to about 5000 ft. The cold-weather brood, which has the ocelli small or obsolete, agrees very well with those which de Nicéville has bred from eggs of *philomela* in Calcutta. In the rains it is more abundant, and the form with ocelli well-marked is then the only one found, but the species occurs during the whole year in greater or less numbers.

70. *Ypthima newara.*

Ypthima newara, Moore, P. Z. S., 1874, p. 567; Butt. Ind., i., p. 222.
Y. nareda, Hew., Trans. Ent. Soc. Lond., 1864, p. 285, t. xvii., 7.

This occurs in Sikkim from the Terai up to about 5000 ft. from May to September. My specimens agree with those from Cachar and Aracan, but I have none from Nepal, which de Nicéville says are probably *nareda*.

71. *Ypthima narasingha.*

Ypthima narasingha, Moore, Cat. E. I. C., p. 236 (1857); Butt. Ind., i., p. 225; Hew., Trans. Ent. Soc. Lond., 1864, p. 291, t. xviii., 19.

This distinct species I have only seen in Hewitson's and the British Museum collections. Neither Möller,

de Nicéville, or Knyvett have ever procured it, and it may not occur in Sikkim.

72. *Ypthima hubneri.*

Ypthima philomela, Hubner (nec Linn.), Zutr. Ex. Schmett., t. 83, 84 (1818).
Y. hübneri, Kirby, Cat. Di. Lep., p. 95 (1871); Butt. Ind., i., p. 226, t. xvii., 65, ♂.
Y. hubneri et *howra*, de Nicé., J. A. S. B., 1886, p. 231.

Occurs in the Terai during the rainy season, but, as far as we know, not in the hills.

73. *Ypthima sakra.*

Ypthima sakra, Moore, Cat. E. I. C., p. 236 (1857); Butt. Ind., i., p. 232, t. xvii., 67, ♂.
Y. nikæa, Moore, P. Z. S., 1874, p. 567; Butt. Ind., i., p. 232.

The commonest species of the genus at 4 to 8000 ft. elevation, and occurs as low as 2000 ft. from March to November. This is one of the commonest roadside insects in Sikkim among grass and bushes, and does not seem to vary much, except in the form and number of the ocelli, which are larger in the Sikkim and Khasia insect than in those separated as *Y. nikæa* from the N.W. Himalaya. In a series of fourteen pairs from all these localities I find no constant characters by which two forms can be distinguished. I have a specimen from Ta-tsien-lo, E. Tibet, in which the ocelli are very large.

74. *Ypthima methora.*

Ypthima methora, Hew., Trans. Ent. Soc. Lond., 1864, p. 291, t. xviii., 20, 21, ♀.

The species which I take to be the *Y. methora* of Hewitson, though it is not the same as that identified by Marshall and de Nicéville, is a large insect, which seems to me to be nearest to *Y. sakra*, and belongs to the group which has no sexual mark on the fore wing of the male.

It has the ocelli as in *Y. sakra*, but the double-pupilled one on the fore wing is usually larger, and those

on the under side in the commoner cold-weather form are very small. But I have three specimens taken by myself at Pashok in Sikkim, and at Mamloo in the Khasia Hills, in August and September, which I take to be the wet-season form of this species, in which the ocelli of the under side are as large and distinct as in *Y. sakra.* *Y. methora* is, however, always distinguished from *sakra* by the striation of the under side, and by the band crossing both wings, which is most conspicuous in the female; and my Sikkim and Bhotan females of the cold-weather brood, taken in February and March, agree with one from Burmah named *methora* by Moore. It is distinguished from *philomela* of Hubner by its constantly much larger size—about two inches and over—and, though in the 'Butterflies of India' the size of *Y. philomela* is given as exceeding two inches in some specimens, yet I have none from Sikkim which can be confused with *Y. methora* even in the female sex. The types of *methora* which I have examined in the Hewitson collection are three females, and agree with mine.

75. *Œneis pumilus.*

Chionobas pumilus, Feld., Reise Nov., iii., p. 490, t. lxix., figs. 6, 7 (1866); Elwes, P. Z. S., 1882, p. 404, t. xxv., fig. 3.

Œneis pumilus, Butt. Ind., p. 238, t. xv., fig. 37, ♂.

Only occurs in the interior at great elevations, and not in British Sikkim. I have received others from the same source as those I described above, and though there is, as de Niceville says, a considerable difference between them and Felder's species from Ladak, both in the deeper brown colour and in the more conspicuous bands on both wings, yet all the markings are identical in form, and I should not like to separate the Sikkim from the Ladak race without seeing a large series of the latter.

76. *Callerebia annada.*†

Erebia annada, Moore, Cat. E. I. C., p. 226 (1857).

Callerebia annada, Butt. Ind., i., p. 245.

I have no specimens taken in recent years in Sikkim,

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† *C. annada* was taken in 1887 by Mr. Knyvett's native collectors in the interior of West Bhotan, near the Sikkim frontier.

but two which were contained in Wilson's Sikkim collection are somewhat larger than those from Kulu and Nepal, and are intermediate between it and *C. scanda*. The types of *annada* were taken in Bhotan by Pemberton, and *C. scanda* is recorded by Moore from Darjeeling. Until more specimens are procured it must remain doubtful as to whether a *Callerebia* exists in Sikkim, and, if so, to what species it belongs.

C. hyagriva (*Ypthima hyagriva*, Moore, Butt. Ind., i., p. 226, t. xvii., 64, ♀) is also recorded from Sikkim, but I have never seen a specimen except from Kulu.

77. *Zipætis scylax.*

Zipætis scylax, Hew., Ex. Butt., iii., p. 100, t. *Zipætis*, fig. 7 (1863); Butt. Ind., p. 249, t. xvii., 62, ♀.

Not a common species in Sikkim, and only found in low, hot valleys at 1—3000 ft. from May to November. I took it near the Tista Bridge in August, and noticed that its flight and appearance were similar to those of an *Ypthima*.

78. *Melanitis leda.*

Papilio leda, Linn., Syst. Nat., i., p. 773 (1767).
P. ismene, Cram., Pap. Ex., i., t. xxvi., A, B (1775).
Melanitis leda, Fab., Butt. Ind., i., p. 252.
M. ismene, Butt. Ind., i., p. 256.
M. leda et *ismene*, de Nicé., J. A. S. B., 1886, p. 237, t. xii., 4.
? *M. bela*, Moore, Cat. E. I. C., i., p. 223 (1857); Butt. Ind., i., p. 563.

Not so common in Sikkim as in the plains, but it occurs all the year round at low elevations, and I have taken *M. leda* in July as high as 7000 feet.

After de Nicéville has proved by breeding that the two very distinct-looking insects known as *leda* and *ismene* are, in Calcutta at least, only seasonal forms of the same species, I confess I do not very well know how to treat the other forms of the genus occurring in Sikkim, of which Möller recognises three, namely :—

Melanitis zitenius.

Papilio zitenius, Herbst, Nat. Schmett., viii., p. 5, t. clxxxii., i., 2 (1776); Butt. Ind., i., p. 258.
Melanitis zitenius, Dist., Rhop. Mal., p. 412, t. xxxviii., 2, ♂, (1886).

This occurs in Sikkim commonly from April to November.

Melanitis duryodana.

Melanitis duryodana, Feld., Reise Nov., iii., p. 464 (1867); Butt. Ind., i., 257.

Recorded by Möller in the autumn months only from September to November, but occurred in 1887 in March.

Melanitis aswa.

Melanitis aswa, Moore, P. Z. S., 1865, p. 769; Butt. Ind., i. p. 253.

This form varies more or less in shape and markings, and is found at the same elevations as the preceding three from 2 to 4000 ft. from April to November. I have only taken it at Mongpo in August. Möller is inclined to regard this as the wet-season form of *duryodana*.

I have tried in vain to separate the species by the key to the genus given in the 'Butterflies of India,' but I find that, though picked specimens may be separated, there remain a number of others which combine some of the characters of the different forms in a greater or less degree. Neither size, shape, or markings on either side have any constancy, and some of the forms seem to be present in almost all the localities of the Eastern Himalaya, as Assam and Tenasserim, where collections have been made. If any one can show that any of these forms can be defined by any fixed characters, however trifling, or that any characters exist in them which are only found in specimens from particular districts, or taken at a particular season, I shall be very ready to recognise them. Until then I think it is better to keep them together, as there is certainly less difference between some specimens of *aswa* and *leda*, or of *ismene* and *duryodana*, than there is between *leda* and *ismene*, which are proved to be one.

79. *Cyllogenes suradeva.*

Melanitis suradeva, Moore, Cat. E.I.C., i., p. 225 (1857).

Cyllogenes suradeva, Butt. Ind., i., p. 260, t. xiii., 30, ♂ ♀.

Not so rare in Sikkim as supposed, but local, and, as far as known, confined to an elevation of about 2000 ft., where it is taken by Moller's collectors at Singla from April to June. An allied species is found in Bhotan, but, as far as I know, the genus does not occur elsewhere.

80. *Elymnias undularis.*

Papilio undularis, Drury, Ill. Ex. Ent., ii., t. x., 1, 2 (1773).

Elymnias undularis, Butt. Ind., i., p. 266, t. xvii., 59, ♂ ♀.

Found from the Terai up to 3000 ft. more or less commonly at all seasons of the year.

81. *Elymnias leucocyma.*

Biblis leucocyma, God., Enc. Meth., ix., p. 326 (1819).

Melanitis malelas, Hew., Ex. Butt., iii., t. Mel., 6, 7 (1863), ♂.

Elymnias leucocyma, Butt. Ind., i., p. 273, t. xvii., 60, ♂ ♀.

Not rare in the low valleys from the Terai up to 3000 ft. during almost every month in the year.

82. *Elymnias (Dyctis) patna.*

Melanitis patna, Westw., Gen. D. L., p. 405, note, t. lxviii., 2 (1851).

Elymnias patna, Wall., Trans. Ent. Soc. Lond., 1869, p. 327.

Dyctis patna, Butt. Ind., i., p. 277.

Not a common species in the low valleys up to 3000 ft. between April and October.

83. *Elymnias (Dyctis) vasudeva.*

Elymnias vasudeva, Moore, Cat. E. I. C., p. 238.
E. thycana, Wall., Trans. Ent. Soc. Lond., 1869, p. 323.
Dyctis vasudeva, Butt. Ind., i., p. 278, t. xvii., 61, ♂.

Not uncommon in the low valleys at 1—2000 ft. from May to October.

84. *Elymnias timandra.*

Elymnias timandra, Wall., Trans. Ent. Soc. Lond., 1869, p. 326.

A single female, which seems to agree with *timandra*, Wall., was received by Möller from his Singla collector in April, 1887. I have not, however, seen this specimen.

MORPHINÆ.

85. *Discophora celinde.*

Papilio celinde, Stole, Suppl. Cram. Pap. Ex., t. xxxvii., 1, 1*a*, ♂ (1790).
Discophora celinde, Rhop. Mal., p. 75, t. v., figs. 10, 11, ♂ ♀; Butt. Ind., i., p. 295.

Not rare in the lower valleys of Sikkim up to about 2000 ft. from March to November.

86. *Discophora tullia.*

Papilio tullia, Cram., Pap. Ex., i., t. lxxxi, A, B (1775).
Discophora tullia, Moore, Cat. E. I. C., p. 211, t. xii., 15, 15*a*; Butt. Ind., p. 298.

Common in Sikkim at the same elevation as the last, perhaps extending a little higher, and occurring throughout the year.

87. *Discophora spiloptera*, de Nicé. & Möller, n. s.

"Expanse: ♂, 3·84 in.; ♀, 4·24 in.

♂. Upper side: Both wings deep black. Fore wing with the costa and outer margin narrowly ochreous; a discal series of four small spots, the upper one in the upper discoidal interspace yellowish white, the one in the upper median interspace obsolete, that in the lower median interspace lengthened into a streak, the lowermost in the submedian interspace round and divided into a large anterior and small posterior portion by a black line; these

three latter spots rich ochreous; a submarginal series of five rich ochreous spots, the three middle ones wedge-shaped, the upper and lower rounded; beyond these spots are five similar small decreasing rounded spots. Hind wing with a rounded discal spot in the subcostal interspace, and a much smaller obsolescent one in the interspace below; a submarginal and marginal series of five spots much as in the fore wing; the outer margin more broadly ochreous. Under side: Both wings marked much as in *D. tullia.*

♀. Upper side: Fore wing with a discal series of six spots, the two upper ones tinted with white, the rest ochreous, that in the lower discoidal interspace a mere line, the two following diamond-shaped, the lowest spot rounded; a submarginal and marginal series of five very large ochreous spots, the apices of the three posterior spots in the marginal series touching the middle of the outer edges of the three in the submarginal series. Hind wing with three series of large ochreous spots, the two outer series almost coalescing. Under side paler than in the male."

Hab. Sikkim.

"Differs in both sexes from *D. tullia* in having the spots of the upper side much larger, and almost all of them ochreous instead of violet-white. Differs also from *D. zal*, of which the female only has been described and figured, and which is probably a variety or 'sport' of *D. tullia*, in all the spots of the upper side being larger, and the two upper spots of the inner series of the fore wing just tinted with violet-white, instead of the whole series being of that colour, as in *D. zal.*

Two males and a female taken in the middle of March, 1887, at about 2000 ft. elevation by my native collectors" (*Möller*).

For the foregoing description I am indebted to Mr. de Nicéville, never having seen the species in question.

88. *Enispe euthymius.*

Adolias euthymius, Doubl., Ann. Nat. Hist., 1845, p. 179.

Enispe euthymius, Doubl. Hew., Gen. Di. Lep., ii., p. 292, t. 40, fig. 2, ♂ (1850).

E. euthymius, Butt. Ind., i., p. 300.

? *E. tessellata*, Moore, P. Z. S., 1883, p. 521.

Not uncommon at low elevations in Sikkim from April to October. I hardly think that the form described from Nepal as *E. tessellata* is distinguishable from this.

89. *Enispe cycnus.*

Enispe cycnus, Westw., Gen. Di. Lep., ii., p. 330 (1851); Butt. Ind., i., p. 301.

This occurs not uncommonly at Buxa, in Bhotan, but I know of no specimens having been recently taken in Sikkim, though a female in the Calcutta Museum is said to have come from this country.

90. *Thaumantis diores.*

Thaumantis diores, Doubl., Ann. Nat. Hist., 1845, p. 234; Butt. Ind., i., p. 304.

T. ramdeo, Moore, Cat. E. I. C., i., p. 215; Butt. Ind., p. 305.

This fine species is not uncommon in shady ravines at 2—4000 ft. elevation in Sikkim, and flies slowly among dense herbage near the ground in the shade. The form described as *ramdeo*, which is larger, and has the blue patch also larger, is not, I think, constant, and Möller considers it only a second brood of *diores*, which he gets from April to June; whilst *ramdeo* occurs later in the year from about August to October.

91. *Stictopthalma camadeva.*

Morpho camadeva, Westw., Cab. Or. Ent., p. 9, t. iv. (1848).

Stictopthalma camadeva, Butt. Ind., i., p. 309.

Not uncommon in suitable localities, which are somewhat similar to those frequented by the last species, from May or June to October. I found it not uncommon by the river at Choongtong, below my tea-garden, at 2500 ft. in July, but difficult to take in good condition, as it flies so close to the ground among thick vegetation that it is not easy to get a clear stroke of the net.

92. *Stictopthalma nourmahal.*

Thaumantis nourmahal, Westw., Gen. Di. Lep., ii., p. 337 (1851).

Stictopthalma nourmahal, Butt. Ind., i., p. 312.

The only authority we have for the occurrence of this species in Sikkim is that of Moore, who has a specimen

probably collected by Major Sherwill and marked Darjeeling. This, however, may have come from Bhotan, as the species has been recently re-discovered near Buxa by Mr. Knyvett, who has procured it in some numbers, and in both sexes. There are a considerable number of species recorded from Sikkim, which are either of doubtful occurrence or extremely rare there, and which occur not uncommonly at Buxa. As the late Mr. Mandelli was in the habit of sending his collectors to the Bhotan Terai, and many officers were employed there during the Bhotan war, who afterwards came to Darjeeling, it is impossible to say whether these really occur west of the Tista or not.

93. *Clerome arcesilaus.*

Papilio arcesilaus, Fab., Mant. Ins., ii., p. 28 (1787); Don., Ins. Ind., t. xxx. (1800).

Clerome arcesilaus, Doubl., Hew., Gen. Di. Lep., ii., p. 334, t. liv. (1851); Butt. Ind., i., p. 313.

This also is recorded from Sikkim only on the authority of Mandelli's collection, and has never been seen recently by Möller or myself.

94. *Amathusia portheus.*

Amathusia portheus, Feld., Reise Nov., iii., p. 461 (1865); Butt. Ind., i., p. 293, cut.

Another species which occurs very rarely, if at all, in Sikkim, and which I include only on the authority of a male specimen in the Indian Museum, said to have come from there.

95. *Pareba vesta.*

Papilio vesta, Fab., Mant. Ins., ii., p. 14 (1787); Don., Ins. China, t. xxx. (1799).

Pareba vesta, Butt. Ind., i., p. 318.

A very abundant species in tea-plantations and cleared land in Sikkim at 2—7000 ft., and also very numerous in some places both in the N.W. Himalaya and in the Khasias, where I found it in the open grassy hills in great quantities. It occurs from April to November. I observed a curious horny appendage to the abdomen of the female in this species, which does not seem to have

been noticed, and which is perhaps analogous, if not identical in character, with the pouch in the genus *Parnassius*. Some very fresh and apparently virgin females, which I took in the Khasias, had not this appendage as yet developed, and it will be interesting to have closer observations as to whether it is produced during coitus, as in *Parnassius*, or not.

96. *Telchinia violæ.*

Papilio violæ, Fab., Syst. Ent., p. 460 (1775).
Telchinia violæ, Butt. Ind., i., p. 320, cut.

Stated by Marshall and de Nicéville to occur not uncommonly in Sikkim, but not included in Möller's Catalogue, and I have no specimens from this country. If it really is found it is probably only as a straggler from the plains.

97. *Ergolis merione.*

Papilio merione, Cram., Pap. Ex., ii., t. cxliv., fig. G, H (1777).
Ergolis merione, Butt. Ind., ii., p. 8, t. xviii., fig. 70, ♂.

A common species at low elevations, and more or less throughout the year.

98. *Ergolis ariadne.*

Papilio ariadne, Linn., Syst. Nat., i., p. 778 (1767); Butt. Ind., ii., p. 10.

Rarer than *merione*, but found occasionally up to 5000 ft. throughout the year.

99. *Euripus consimilis.*

Diadema consimilis, Westw., Gen. Di. Lep., ii., p. 281, ♀ (1850).
Euripus consimilis, W. Mason, J. A. S. B., 1881, pt. ii., p. 85, t. iv., fig. 3, ♀; Butt. Ind., ii., p. 17.

This species rarely occurs in the hills, but in the Terai, and as far out in the plains as Jelpigori, it has been taken by Messrs. Knyvett and Möller in July, August, and December.

100. *Euripus halitherses.*

Euripus halitherses, Doubl., Hew., Gen. Di. Lep., ii., p. 293, t. xli., fig. 2, ♂ (1850); de Nicé., Butt. Ind., ii., p. 18, t. xx., fig. 90, ♂ ♀.
Hestina isa, Moore, Cat. Lep. E. I. C., p. 161, ♀.
Diadema nyctelius, Doubl., Ann. Nat. Hist., 1845, p. 182, ♀.
Euripus cinnamomeus, W. Mason, J. A. S. B., 1881, pt. 2, p. 272, t. iv., ♀.
E. euplœoides, Feld., Reise Nov., iii., p. 415 (1866); Dist., Rhop. Mal., p. 134, t. xiii., 6 ♂, 7 ♀ (1882).

The numerous variations to which the females of this species are subject have rendered its synonymy rather intricate, but, as the question is ably worked out by de Nicéville in the 'Butterflies of India,' I need not refer to them at length.

The variable form *isa*, which mimics *Euplœa rhadamanthus*, and the more constant form *nyctelius*, which mimics *E. midamus*, male, are both found in the valleys up to about 3000 ft. with the male, which does not seem to vary, from April until the end of the year, but are not abundant at any season.

Dilipa morgiana has been taken in Bhotan by Mr. Knyvett's collectors, but has not yet been recorded from Sikkim.

101. *Cupha erymanthis.*

Papilio erymanthis, Drury, Ill. Ex. Ent., i., t. iv., figs. 3, 4 (1770).
Cupha erymanthis, de Nicé., Butt. Ind., ii., p. 22, t. xxiii., fig. 105, ♂.

Not common in Sikkim, but occurs up to 4 or 5000 ft. from March to October.

102. *Melitæa sindura*, var. (Pl. X., figs. 5 ♂, 6 ♀).

Melitæa sindura, Moore, P. Z. S., 1865, p. 496, t. xxx., fig. 2; Butt. Ind., ii., p. 25.
M. amænula, Feld., Reise Nov. Lep., ii., p. 392 (1867).
? *M. Jezabel*, Ober., Et. Ent. In., xi., p. 17, t. ii., fig. 14 (1887).

Though I hesitate to give a new name to a form of so difficult and variable a genus as *Melitæa*, yet, if all the insects from Ladak are as different from those found in the Eastern Himalaya as the typical specimen described by Moore, one of which is in my collection, I should consider it necessary to separate them.

Though I have not seen Felder's type, which came from the same region as *sindura*, I have little doubt that it is identical; but this Ladak form is so much lighter than any of the specimens which I have received through native collectors from the frontier of Sikkim and Chumbi that it can be distinguished at a glance.

The Sikkim form, however, is very variable, and, as the range of the insect doubtless extends all along the north of Nepal to Ladak, it is probable that whatever differences are perceptible between specimens from the extreme localities would be bridged over by intermediate varieties.

Of twelve males and eight females in my collection, the average are about the same size, and not unlike *M. aurelia* of Europe; but the males are redder in tint, and in both sexes the dark markings are much heavier both on the margins and inner part of the wings.

The silvery markings of the under side distinguish the species from any other; the colour and breadth of the submarginal fulvous band on the hind wings below is very variable, but the pattern is similar to that of *sindura*. I have found all attempts to describe nearly-allied species of Melitæas in words useless, so have given an exact figure of the insect.

Though I cannot give its exact habitat, it is certainly at a high elevation in the interior of Eastern Sikkim or Western Bhotan. *Melitæa Jezabel*, Oberthür, resembles it closely on the upper side, but the under side of that insect is more like that of typical specimens of *sindura* from Ladak.

103. *Atella sinha.*

Temios sinha, Koll., Hugel's Kash., p. 438 (1848); Butt. Ind., ii., p. 29, t. xx., fig. 87, ♀.

Not common in Sikkim, where, however, it occurs at 2—3000 ft. between May and October. In the Khasias it is found up to 5000 ft. in open grassy places.

104. *Atella phalanta.*

Papilio phalanta, Drury, Ill. Ex. Ent., i., t. xxi. (1770).
Atella phalanta, Butt. Ind., ii., p. 30, t. xx., fig. 88, ♂.

Not common in the hills, but occurs up to 5000 ft. between March and October.

105. *Atella alcippe.*

Papilio alcippe, Cr., Pap. Ex., iv., t. 389, fig. G, H (1782).
Atella alcippe, Butt. Ind., ii., p. 31.

Rare in Sikkim at low elevations in April and May.

106. *Cethosia cyane.*

Papilio cyane, Drury, Ill. Ex. Ent., i., t. iv. (1770).
Cethosia cyane, Butt. Ind., ii., p. 33.

Common in Sikkim up to 3 or 4000 ft. from April to December.

107. *Cethosia biblis.*

Papilio biblis, Drury, Ill. Ex. Ent., i., t. iv. (1770).
Cethosia biblis, Butt. Ind., i., p. 36.

Abundant up to 6 or 7000 ft. at the same seasons as the last.

108. *Cynthia erota.*

Papilio erota, Fab., Ent. Syst., iii., p. 76 (1793).
Cynthia erota, Butt. Ind., ii., p. 41, t. xxi., fig. 97, ♂ ♀.

Common up to 5 or 6000 ft. from May to December; the females rarer. Möller found numbers of the larvæ of this species feeding, in company with those of *C. cyane* and *C. biblis*, on a creeper (*Passiflora* sp.) at 3000 ft. in October.

109. *Helcyra hemina.*

Helcyra hemina, Hew., Trans Ent. Soc. Lond., 1864, p. 245, t. xv., fig. 1; Butt. Ind., ii., p. 43, t. xix., fig. 83, ♂.

One of the rarest butterflies in Sikkim, where it occurs at very low elevations during and after the rains.

110. *Apatura (Sephisa) chandra.*

Castalia chandra, Moore, Cat. E. I. C., p. 200, t. vi., *a*, 4 ♂ (1857); Waterhouse, Aid., i., p. 8, ♀ (1880).
Sephisa chandra, Butt. Ind., ii., p. 46.

Not uncommon before and after the rains, but local; the female, however, is much rarer, and differs much from the male. The female form found in Sikkim, however, though not constant, is different from the one from Nepal, figured by Waterhouse, and usually has a large patch of white across the purple of the fore wings, and the hind wings of a similar deep purple with paler spots.

The range of this supposed genus, which, however, I do not see my way clearly to separate from *Apatura*, is now much extended by the discovery of a new species in Corea, which is described as *Apatura princeps* by Fixsen; also described by Leech, P. Z. S., 1887, p. 417, as *Apatura cauta*. Another species, or variety, occurs in East Tibet, and will no doubt be soon published by Oberthür.

111. *Apatura namouna.*

Apatura namouna, Doubl., Ann. Nat. Hist., 1845, p. 178; Butt. Ind., ii.. p. 50, t. xx., fig. 91, ♂.
A. ambica, Koll., Hugel's Kash., p. 431, t. viii., 3, 4 (1848).
A. zanoa, Hew., Ex. Butt., iv., t. i., figs. 7, 8 (1869).
A. bhavana, Moore, Trans. Ent. Soc. Lond., 1881, p. 307; Waterhouse, Aid. ii., t. 127 (1883).

Males common at low elevations up to about 4000 ft., but the females are quite rare. This is a very bold insect, and will return to its settling-place after three or four attempts to catch it have been made; it has a strong, rather jerking, flight, and is very restless. It is curious that this, as well as many other species, occur in the North-west Himalaya at greater elevations than in Sikkim.

I can see no reason for separating *A. bhavana*, and, though an 'Aid to Identification' is very necessary, in order to understand a great many types in the British Museum, I think it might be more usefully applied to less doubtful species than this.

112. *Apatura chevana.*

Athyma chevana, Moore, P. Z. S., 1865, p. 763, t. xli., fig. 1.

Apatura chevana, Butt. Ind., p. 52.

This very beautiful species is seldom found at low elevations between April and October. The only female I have seen is in Möller's collection. It is much larger and yellower in tint than the male, and quite devoid of blue gloss.

113. *Apatura parvata.*

Apatura parvata, Moore, Cat. Lep. E. I. C., p. 202, t. vi. *a*, 6 (1857), ♂; Butt. Ind., ii., p. 53.

Very rare in Sikkim, where I do not know its habitat or season, but common at Buxa.

114. *Apatura sordida.*

Apatura sordida, Moore, P. Z. S., 1865, p. 765, t. xli., 2, ♂; Butt. Ind., ii., p. 52.

Also a very rare species, which has been taken by Messrs. Moller and de Nicéville at low elevations in Sikkim from June to October.

115. *Apatura parysatis.*

Apatura parysatis, Westw., Gen. Di. Lep., ii., p. 305 (1850); Butt. Ind., ii., p. 54, t. xx., fig. 92, ♂ ♀.

The male of this small and curiously-coloured insect is the blackest butterfly I know. The female, which is much rarer, is, however, very unlike it on the upper side. It occurs up to 6000 ft. from April to November.

116. *Hestina nama.*

Diadema nama, Doubl., Ann. Nat. Hist., 1845, p. 232; Gen. Di. Lep., ii., t. xxxix., fig. 2.

Hestina nama, Butt. Ind., ii., p. 56, t. xxii., fig. 99, ♀.

Very common up to 6000 ft., but most abundant at 3 or 4000 ft. from March to December. Mr. de Nicéville says that it exactly mimics *Danais tytia*, but I cannot see the resemblance myself, as the flight of the latter is so different that I could distinguish it at a

glance. I found the female abundant, as well as the male.

117. *Hestina persimilis.*

Diadema persimilis, Westw., Gen. Di. Lep., p. 281 (1850).
Hestina persimilis, Butt. Ind., ii., p. 58.
? *H. zella*, Butl., Trans. Ent. Soc. Lond., 1869, p. 9; Moore, P. Z. S., 1882, p. 240.

Quite a rare insect, and apparently only found at low elevations in Sikkim, though at Simla it occurs from 4 to 7000 ft. I have never seen a female from Sikkim.

118. *Herona marathus.*

Herona marathus, Doubl., Hew., Gen. Di. Lep., ii., p. 294, t. xli., fig. 3 (1850); Butt. Ind., ii., p. 61.
? *H. angustata*, Moore, P. Z. S., 1878, p. 879; Butt. Ind., ii., p. 62.

Not common in Sikkim at 3—4000 ft. during and after the rains. A specimen from the east side of the Tista, taken in March, is much smaller and paler in colour, forming an intermediate link with *H. angustata*.

119. *Precis iphita.*

Papilio iphita, Cram., Pap. Ex., iii., p. ccix., fig. C, D (1779).
Precis iphita, Butt. Ind., p. 63, t. xix., fig. 84, ♂.

A very abundant species here as elsewhere in the wetter parts of India. Occurs up to 7 or 8000 ft., and all the year round.

120. *Junonia asterie.*

Papilio asterie, Linn., Syst. Nat., x., p. 472 (1758); Butt. Ind., p. 67.
? Gen. ii. *Junonia almana.*
Papilio almana, Linn., *l. c.*; Butt. Ind., p. 68.

Not rare at low levels at all seasons in the year. De Nicéville's suggestion that the two insects above quoted are seasonal forms of each other is confirmed by Möller, and seems to be most probably correct, though the two forms do not seem to be invariable, or to occur only in the wet and dry seasons respectively.

121. *Junonia atlites.*

Papilio atlites, Linn., Cent. Ins., p. 24 (1763, *fide* Aurivillius); Butt. Ind., p. 69.

P. laomedia, Linn., Syst. Nat., p. 772 (1767), et auctorum.

Occurs rarely in the hottest valleys, but common in the Terai at all seasons.

122. *Junonia lemonias.*

Papilio lemonias, Linn., Syst. Nat., x., p. 473 (1758).

Common up to 5000 ft., and found all the year round.

123. *Junonia œnone.*

Papilio œnone, Linn., Mus. Ulr., p. 294, et auctorum.

Junonia hierta, Fab., Butt. Ind., p. 71, t. xx., fig. 94, ♂ ♀.

Rather an insect of the plains than the hills, but occurs in the low valleys at various seasons. I hardly think Mr. de Nicéville's reasons for adopting Kirby's change of name of so well-known a butterfly are sufficiently strong; the identifications of such descriptions must always be somewhat doubtful.

124. *Junonia orithya.*

Papilio orithya, Linn., Mus. Ulr., p. 278 (1764); Butt. Ind., ii., p. 73.

A common insect at elevations up to 9 or 10,000 ft., but most abundant in cultivated ground and sunny clearings. It settles on the ground with open wings, and has a rapid, strong flight. Occurs at all seasons.

125. *Neptis hordonia.*

Papilio hordonia, Stoll, Suppl. Cram. Pap. Ex., t. xxxiii., fig. 4 (1790); Butt. Ind., p. 78.

? Gen. i. *Neptis plagiosa*, Moore, P. Z. S., 1878, p. 830; Butt. Ind., p. 79.

Common at low levels from March to December, but the form or variety *plagiosa*, which is by no means constant, and differs principally in the broader ferruginous bands, has only been taken in the cold weather.

126. *Neptis radha.*

Neptis radha, Moore, Cat. Lep. E. I. C., p. 166, t. iv. *a*, fig. 4 (1857); Butt. Ind., p. 84.

A rare species in Sikkim, which I have never taken myself, but it occurs between April and October at low elevations.

127. *Neptis miah.*

Neptis miah, Moore, Cat. Lep. E. I. C., p. 164, t. iv. *a* (1857); Butt. Ind., ii., p. 85.

Not uncommon by the river-sides at 1—3000 ft. from April to October.

128. *Neptis ananta.*

Neptis ananta, Moore, Cat. Lep. E. I. C., p. 166, t. iv. *a*, fig. 3 (1857); Butt. Ind., ii., p. 85.

This beautiful insect is an inhabitant of the forest at 5—6000 ft, but is also taken at lower levels. I took two females myself in the forest along the Pashok road above Lopchu in June; they were settled on low herbage by the roadside, and are larger and paler than the males.

129. *Neptis viraja.*

Neptis viraja, Moore, P. Z. S., 1872, p. 563, t. xxxii., fig. 6; Butt. Ind., ii., p. 86.

A very rare species in Sikkim, but Mr. de Nicéville has taken it in the Terai in October, and Mr. Moller has procured it from the Sikkim valleys in March, April, and May.

130. *Neptis zaida.*

Neptis zaida, Doubl., Hew., Gen. Di. Lep., ii., p. 272, t. xxxv., fig. 3 (1850); Butt. Ind., ii., p. 86.

This rare and beautiful species is hardly ever taken by the native collectors now, but I found it in one place not uncommon in June and July. This was in the forest above Rangbi at about 6000 ft. The males fly about the tops of oak-trees in the rare gleams of sunshine, sitting on the leaves, but descend seldom to the ground.

131. *Neptis manasa.*

Neptis manasa, Moore, Cat. E. I. C., p. 165, t. iv. *a*, fig. 2 (1857); P. Z. S., 1858, p. 5; Butt. Ind., ii., p. 87.

This rare and beautiful species has not been previously recorded as occurring in Sikkim, but I took a single fresh male, which agrees with the type of the species, in the forest near the Rangbi jhora, on the road to Serail, at 6000 ft., on June 7th. It is possible that those I saw flying about the tops of the trees near the same place may have been *N. manasa*, and not *zaida*, as I at the time supposed.[+]

132. *Neptis amba.*

Neptis amba, Moore, P. Z. S., 1858, p. 7, t. xlix., fig. 4; Butt. Ind., ii., p. 88.

N. carticoides, Moore, Trans. Ent. Soc. Lond., 1881, p. 309; Butt. Ind., ii., p. 90.

A rare species in Sikkim, which occurs in the lower valleys before and after the rains. I have three males and one female only, which, though they belong to what Moller and de Nicéville call *carticoides*, are, in my opinion, barely distinguishable from *amba* of the North-west Himalaya and Nepal. The wider and purer white bands of *amba*, which are considered to distinguish it from *carticoides*, vary considerably in both forms. I have *amba* from Kangra and Nepal, named by Moore, and from Chumba and Mandi in both sexes. The four females of the north-western form are certainly more fuliginous than in the Sikkim female; and one male from Mandi, which probably would be called *N. amboides* by Moore, has the bands quite as narrow as those from Sikkim.

133. *Neptis cartica.*

Neptis cartica, Moore, P. Z. S., 1872, p. 562; Butt. Ind., ii., p. 89.

This is a distinct species, intermediate between the last and *N. vikasi*, but nearer to *N. amba*, from which it is distinguished by the narrower bands, less pure white, and by the markings of the under side. From *vikasi* it is easily known by its much paler colour and purer white bands. It is not uncommon in the lower valleys from April to October.

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* August, 1888. I have just heard from Mr. Moller that a male of *Neptis narayana*, previously only known from the North-west, has been taken on Tonglo last July.

134. *Neptis vikasi.*

Neptis vikasi, Horsf., Cat. Lep. E. I. C., t. v., figs. 2, 2 *a* (1822); Butt. Ind., ii., p. 91.

Not uncommon up to about 3000 ft. from March to November.

135. *Neptis varmona.*[1]

Neptis varmona, Moore, P. Z. S., 1872, p. 561; Butt. Ind., ii., p. 95.

N. kamarupa, Moore, P. Z. S., 1874, p. 570; Butt. Ind., ii., p. 98.

N. adara, Moore, P. Z. S., 1878, p. 830; Butt. Ind., ii., p. 97.

This, which is one of the widest-ranging of all the Indian species of *Neptis*, is not uncommon in the lower valleys of Sikkim. I have also taken it at Bombay and in the Khasia Hills, and have it from many other parts of India, Ceylon, Burmah, and Tenasserim under the name of *adara*, and also from China, Formosa, and Borneo. I see no possibility at present of separating the varieties under different names, and, though de Nicéville keeps the two which are called *adara* and *kamarupa* separate in the 'Butterflies of India,' he says that he cannot distinguish *adara*; and Mòller and de Nicéville both believe that *kamarupa* is almost certainly the dry-weather form of *varmona*.

136. *Neptis astola.*

Neptis astola, Moore, P. Z. S., 1872, p. 560; Butt. Ind., ii., p. 99.

N. emodes, Moore, *l. c.*, p. 561, t. xxxii., fig. 2; Butt. Ind., ii., p. 99.

Though this species is nearly allied to *varmona*, it can be distinguished, I think with certainty, by the chocolate-red rather than ochreous-colour of the under side. I am, however, quite unable, as is de Nicéville, to see how to distinguish *emodes* from *astola*. It is a common species

[1] I am very doubtful whether this is not identical with *N. Eurynome*, West., Don. Ins. China, p. 66. Since writing the above I have received specimens from Kiukiang, China, identified by Leech with *Eurynome*, which only differ in size from Indian and hardly at all from Burmese specimens of *varmona*.

at elevations up to 4000 ft. or more in Sikkim from April till December.

137. *Neptis soma.*

Neptis soma, Moore, P. Z. S., 1858, p. 9, t. xlix., fig. 6; Butt. Ind., ii., p. 102, t. xxiii., fig. 108.

What I believe to be this species is not rare in the valleys up to 3000 ft. from March to December.

137*b*. ? *Neptis adipala.*

Neptis adipala, Moore, P. Z. S., 1872, p. 563, t. xxxii., fig. 8; Butt. Ind., ii., p. 102.

I have no Sikkim specimens which exactly agree with the figure of this species, which was described from the Khasia. De Nicéville says that there is a Sikkim specimen named *adipala* by Moore in the Calcutta Museum. I have seen specimens in Mr. Moore's collection so-called, in which the middle band and discoidal streak are more smoky and less defined than in *N. soma;* but I do not see that they can be separated.

? 138. *Neptis susruta.*

Neptis susruta, Moore, P. Z. S., 1872, p. 563, t. xxxii., fig. 4; Butt. Ind., ii., p. 103.

I am also unable to match the figure of this species with Sikkim specimens, and can only rely on what de Nicéville says as to Sikkim specimens having been so named by Moore. I am, however, doubtful whether the last three species can be separated with certainty; they are certainly very nearly allied.

139. *Neptis nandina.*

Neptis nandina, Moore, Cat. Lep. E. I. C., p. 168, t. iv. *a*, fig. 7; Butt. Ind., ii., p. 104.

This belongs to a well-marked group, which can easily be distinguished by the broad bands of the under side. It is compared by Moore with *Aceris*, but, though nearly allied to that species, of which I consider *mahendra*, Moore, from the North-west Himalaya, to be the nearest Himalayan representative, it is perhaps distinct from it.

It occurs not uncommonly in Sikkim up to 4000 ft. from April to December.

140. *Neptis ophiana.*

Neptis ophiana, Moore, P. Z. S., 1872, p. 561; Butt. Ind., ii., p. 205.

Not uncommon in Sikkim at low elevations up to 3000 ft. between March and December. It is a question as to whether this is really distinct from *columella*, Cram., and, until a series of Chinese specimens can be procured for comparison, I do not see that it is possible to decide the question.

141. *Cirrhochroa aoris.*

Cirrhochroa aoris, Doubl., Hew., Gen. Di. Lep., i., p. 158, t. xxi., fig. 2, ♂ (1848); Butt. Ind., ii., p. 109.

C. abnormis, Moore, J. A. S. B., 1884, pt. ii., p. 19; Butt. Ind., ii., p. 110.

Common up to about 6000 ft. from April to December. The insect described as *abnormis* is no doubt a variety of this; no characters are given in the description by which it can be separated from *aoris*.

142. *Cirrhochroa mithila.*

Cirrhochroa mithila, Moore, P. Z. S., 1872, p. 558; Butt. Ind., ii., p. 114.

C. rotundata, Butl., Trans. Linn. Soc., 1877, p. 543; Butt. Ind., ii., p. 114.

C. anjira, Moore, P. Z. S., 1877, p. 584; Butt. Ind., ii., p. 115.

A fairly common species up to 4 or 5000 ft. in some localities, and agrees very well with specimens from Burmah and Cachar. I agree with de Nicéville in thinking that *rotundata* cannot be separated from *mithila*, and the same may be said of *C. anjira*, Moore.

143. *Pseudergolis wedah.*

Ariadne wedah, Koll., Hugel's Kash., p. 437 (1848).

Precis veda, Kirby, Cat. Di. Lep., p. 191 (1871).

Precis hara, Moore, Cat. Lep. E. I. C., p. 143, t. iii. *a* (1857).
Pseudergolis wedah, Butt. Ind., ii., p. 120, t. xxiii., fig. 109.

Common from 2 to 6000 ft. between March and November. De Nicéville says he has always taken this species near water, but I have found it in the rains most abundant in second-growth jungle and open places, such as the road between Lopchu and Pashok.

144. *Stibochiona nicea.*

Adolias nicea, Gray, Lep. Nep., p. 13, t. xii. (1846).
Stibochiona nicea, Butl., P. Z. S., 1868, p. 614; Butt. Ind., ii., p. 120, t. xix., fig. 81, ♂.

Common from about 2 to 5000 ft. between March and November.

145. *Hypolimnas bolina.*

Papilio Bolina, Linn., Syst. Nat., x., p. 479.
Hypolimnas bolina, Kirby, Cat. Di. Lep., p. 224; Butt. Ind., ii., p. 123.
Diadema auge, Moore, Cat. Lep. E. I. C., p. 158, t. v., figs. 9, 9 *a*, larva.
Apatura jacintha, Moore, Lep. Cey., p. 58, t. xxx., fig. 1 *a*, ♀.

Common all the year round in the low valleys up to about 3000 ft.

146. *Hypolimnas misippus.*

Papilio misippus, Linn., Mus. Ulv., p. 264.
Hypolimnas misippus, Kirby, Cat. Lep., p. 225; Butt. Ind., ii., p. 126, t. xx., fig. 85, ♂ ♀.

Very rare in Sikkim, where Möller's collectors have taken it at 2000 ft. in August. In the N.W. Himalaya it occurs more commonly, but is an insect characteristic of the drier parts of India in the plains.

147. *Argynnis niphe.*

Papilio niphe, Linn., Syst. Nat., xii., p. 785 (1767).
Argynnis niphe, Butt. Ind., ii., p. 131.
A. aruna, Moore, Cat. Lep. E. I. C., p. 156, t. iii. *a*, fig. 4, ♂.

A common species up to 5000 ft., but mostly found in tea-gardens, or places where the forest has been cleared. Occurs from March to December.

148. *Argynnis childreni.*

Argynnis childreni, Gray, Zool. Misc., i., p. 33 (1831); Lep. Nep., t. xi., ♂ (1846); Butt. Ind., ii., p. 132.
A. sakontala, Koll., Hugel's Kash., p. 439, t. xii., ♂ ♀ (1848).

Möller notes the occurrence of this species at 3—4000 ft., but I have only seen it rarely on Tonglo and the Singalelah Range in open flowery places in the forest, where it settles on flower-heads at 9—12,000 ft. It occurs from June to October.

149. *Argynnis lathonia.*

Papilio lathonia, Linn., Faun. Suec., p. 282 (1761); Butt. Ind., ii., p. 137.
Argynnis issæa, Gray, Lep. Nep., p. 11 (1846).

Not a common insect in British Sikkim, where I have only taken it on the open parts of the Singalelah Range beyond Sundukpho in July, but it has been taken at Darjeeling in winter, and as low as 5000 ft. in February. Judging from the very numerous specimens brought by native collectors, it is very common in the interior.

150. *Argynnis gemmata.*

Argynnis gemmata, Butl., Ann. Nat. Hist. (1881), p. 32, t. iv.; Butt. Ind., ii., p. 138; Elwes, P. Z. S., 1882, p. 404, t. xxv., figs. 6, 7, ♂ ♀.

I saw this insect first on the high Chola Range in 1870, and have since obtained it in quantity from natives who had been sènt to Chumbi and Western Bhotan. It varies only in size, as far as I have seen, and the Sikkim form is the same as the two types in the British Museum, which probably came from northern Gurwhal. It has never been found on the outer ranges.

151. *Argynnis altissima.*

Argynnis altissima, Elwes, P. Z. S., 1882, p. 403, t. xxv., fig. 8; Butt. Ind., ii., p. 139.

Only found in the high ranges on the eastern frontier, and in Bhotan; the exact locality and elevation unknown, as it has never been taken by a European. Those which I have received recently from Bhotan are somewhat larger than the type, but do not vary except in size. The female differs in the same way as that sex of *A. gemmata* does from the male.

152. *Argynnis pales.*

Argynnis pales, Schiff., S. V., p. 177.
A. sipora, Moore, P. Z. S., 1874, p. 568, t. lxvi., fig. 11; Butt. Ind., p. 139, t. xviii., fig. 72.
A. baralacha, Moore, P. Z. S., 1882, p. 242, t. xi.

It is quite impossible to separate the Himalayan form of this wide-ranging butterfly from those found in almost all the higher ranges of Turkestan, Siberia, and Europe. I have a very large series of both sexes, 70 males and 50 females, from many localities in Europe and Asia, and, though the variation is very great, yet I do not think that the forms which have been already separated as varieties are sufficiently constant, though the form described by Staudinger as var. *generator*, Stett. Ent. Zeit., 1886, p. 235, which was found by Mr. Leech on the Deosai plateau of Kashmir, seems in both sexes very different from the form found in Kashmir, Lahoul, and Sikkim. I have in my collection seven females taken in one day in a single meadow in the Alps, no two of which are alike, and, as the majority of those I have from Lahoul are more like European specimens than the Central Asian form *generator*, I do not think they deserve a separate name. The only specimens I have from Sikkim are three bad ones brought by natives with *A. altissima* from Chumbi and Bhotan, where it no doubt occurs at great elevations.*

153. *Dichorragia nesimachus.*

Adolias nesimachus, Boisd., Cuv. Regne An. Ins., ii., t. 149 *bis* fig. 1 (1836).
Dichorragia nesimachus, Butt. Ind., ii., p. 141, t. xix., fig. 82, ♂.

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* I have since learnt that the variety *generator* does not occur on the Deosai plains with the Himalayan form, but was taken on the Skorolah Ladak.

Not uncommon at low elevations between April and November.

154. *Calinaga buddha.*

Calinaga buddha, Moore, Cat. Lep. E. I. C.; Butt. Ind., ii., p. 148, frontispiece, fig. 122, ♂.
C. brahma, Butl., Ann. Nat. Hist., 1885, p. 309 (1885).

A rare species, which probably does not occur in British Sikkim, but has been brought from the central part of native Sikkim by Möller's collectors. I have four specimens in my collection from Sikkim which differ but little from two taken near Dalhousie in the North-west. I have seen the types of Mr. Butler's *C. brahma*, which were collected by Dr. Watt probably in the Naga Hills, on the march from Manipur to Kohima, where he collected in the spring of 1884. I mention this, as the locality given "near Assam" is one of the most remarkable that even Mr. Butler has ever quoted. Kohima and Manipur are certainly near Assam, so is Calcutta.

155. *Penthima lisarda.*

Diadema lisarda, Doubl., Ann. Nat. Hist., 1845, p. 233.
Penthima lisarda, Butt. Ind., ii., p. 144.

This magnificent species is not very rare in May and June at 2—4000 ft. De Nicéville says that it occurs in deep forest, but I have never seen it myself.

156. *Neurosigma doubledayi.*

Acontia doubledayi, Westw., Cat. Or. Ent., p. 76, t. xxxvii., fig. 4 (1848).
Adolias siva, Westw., Gen. Di. Lep., ii., p. 291 (1850).
Neurosigma siva, Butl., P. Z. S., 1868, p. 615; Butt. Ind., ii., p. 151, t. xix., fig. 80.

This fine insect is rare in Sikkim, where I have never seen it myself. Möller, who has the female in his collection, gives the elevation as from 2 to 3000 ft. in April and May, but it must be double-brooded, as I have seen it in the end of September near Cherra Punji, in the Khasias.*

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* Moller has since obtained it in Sikkim in October.

157. *Lebadea ismene.*

Limenitis ismene, Doubl., Hew., Gen. Di. Lep., ii., p. 276, t. xxxiv. (1850).
Lebadea ismene, Butt. Ind., ii., p. 152, t. xix. fig. 79, ♂.

Not uncommon at low elevations between April and December. Varies a good deal in size.

158. *Limenitis danava.*

Limenitis danava, Cat. Lep. E. I. C., p. 180, t. vi. *a*, 2 (1857); Butt Ind., ii., p. 157.

Rare in Sikkim at elevations up to 7000 ft. from April to October. The female, which differs considerably, is seldom found, the only one I have being from Mr. Gammie.

159. *Limenitis daraxa.*

Limenitis daraxa, Doubl., Gen. Di. Lep., ii., p. 276, t. xxxiv., fig. 4 (1850); Butt. Ind., ii., p. 158.

Moller notes this as found from 1 to 8000 ft. between April and November, but I have only taken it myself east of the Tista River, where, along the ridge from Dumsong to Khumpong, it is common in open places in the forest in August at 6000 ft. It settles on the ground with open wings, and is a bold, quick-flying insect, returning several times to the same spot if missed with the net.

160. *Limenitis zulema.*

Limenitis zulema, Doubl., Gen. Di. Lep., ii., p. 276, t. xxxiv. (1850); Butt. Ind., ii., p. 159.

A very rare insect, as neither Moller or I have ever procured it, though I have two specimens from an old Sikkim collection.

161. *Limenitis zayla.*

Limenitis zayla, Doubl., Gen. Di. Lep., ii., p. 276, t. xxxv. (1850); Butt. Ind., ii., p. 159.

This very lovely insect is found not uncommonly in dense forest at 6 to 8000 ft. in June, July, and August. The female, which I have taken myself, does not differ

from the male except in the slightly-broader wings. It is a strong flyer, and settles on the ground like *daraxa.*

162. *Limenitis dudu.*

Limenitis dudu, Westw., Gen. Di. Lep., ii., p. 276 (1850); Butt. Ind., ii., p. 159, t. xxiv., fig. 112, ♂.

A rare species, which has much the same habits as *zayla,* but occurs lower down. The only female which I have seen was taken on the bare hill-top at Jellapahar in July by a soldier.

163. *Limenitis procris.*

Papilio procris, Cr., Pap. Ex., ii., t. cvi, figs. E, F (1777).
Limenitis procris, Butt. Ind., ii., p. 163.

Only found in the Terai and lowest valleys, where it is not so common as in the plains. Flies from March till December.

164. *Athyma perius.*

Papilio perius, Linn., Syst. Nat., x., p. 471 (1758).
P. leucothoe, L., *l c.,* p. 478, et auctorum.
Athyma perius, Butt. Ind., ii., p. 166, t. xx., fig. 89, ♀.

Much rarer in Sikkim than in the North-west Himalaya and Khasia Hills. Moller notes it as found up to 3000 ft. all the year round, but I have never observed it myself.

165. *Athyma jina.*

Athyma jina, Moore, Cat. Lep. E. I. C., p. 172, t. vi. *a* (1857); Butt. Ind., ii., p. 169.

Not a common species, and, as far as I know, confined, like so many of the species peculiar to Sikkim, to the zone of heavy forest between 6 and 8000 ft., where I have taken it in July.

166. *Athyma mahesa.*

Athyma mahesa, Moore, Cat. Lep. E. I. C, p. 176, t. v. *a,* fig. 7 (1857); Butt. Ind., ii., p. 171.
A. ranga, Moore, *l. c.,* p. 175, t. v. *a,* fig. 6; Butt. Ind., ii, p. 172.

I cannot see how to distinguish these two supposed

species, which appear to run into each other. Mr. de Nicéville, who keeps them separate in his book, suggests that *ranga* is the winter or dry-season form of *mahesa*, and says that *ranga* occurs only in the spring and late autumn; but Mr. Moller finds both of them at various seasons from March to December in the warm valleys up to about 3000 ft. *Mahesa* is the commoner form.

167. *Athyma orientalis*, Elwes, n. s. (Pl. IX., fig. 4, ♂.)

Athyma opalina, Koll., in part; de Nicé., Butt. Ind., ii., p. 173.

The species found in Sikkim, which has been included by de Nicéville with *A. opalina*, Koll., from the North-west Himalaya, is, in my opinion, distinct. In Moore's collection it is placed with the female of *A. selenophora* as *A. bahula*, but the description applies to the female of that insect, and therefore the name *bahula* cannot be used for what I now call *orientalis*. I have eight males from Sikkim, one from Nepal, and two from the Khasia, which all agree in being of a much darker colour than any of my specimens of *opalina*, which are from Murree, Simla, Kangra, Mandi, and Chamba; the bands of the hind wing are also narrower, and of a less pure white, so that I should have no difficulty in distinguishing the eastern form if the labels were removed. I have not, however, as yet been able to procure the female of the eastern form, which will probably resemble the male, as does the female of *opalina*. There is no doubt that de Nicéville is correct in identifying *bahula*, Moore, as the female of *selenophora*, as it has a distinct dark brown spot at the base of the hind wing below, which is also present in the male, but not in *orientalis* or *opalina;* and, though the males of *selenophora*, as well as *zeroca*, are very different from their females above, and want the white band on the body which is found in other species of the genus, yet they agree very well on the under side with what we have no doubt are their females.

A. orientalis is found in the forest at 2—7000 ft. elevation from April to October, but is not common, and is difficult to take, as it settles on high trees, and only descends to the ground at long intervals.

168. *Athyma selenophora.*

Limenitis selenophora, Koll., Hugel's Kash., p 426, t. vii., figs. 1, 2 (1848).

Athyma selenophora, Moore, Cat. Lep E. I. C , p. 175; Butt Ind., ii., p. 176.

♀, *A. bahula*, Moore apud de Nicé, Butt. Ind., ii., p. 176

A common species from 1 to 3 or 4000 ft. from March to December. The female is very unlike the male in pattern and colour on the upper side, but may be distinguished by the identity of the markings below; unless these are closely compared it would rather be taken for the female of the last species.

169. *Athyma zeroca.*

Athyma zeroca, Moore, P. Z. S., 1872, p. 564; Butt· Ind , ii., p. 177.

Found at the same elevation and seasons as the last, but not so common. The female, first described by de Nicéville, is very different from the male above, but may be recognised by comparing the pattern of the under side. It is rare, like the females of *selenophora* and *cama*.

170. *Athyma cama.*

Athyma cama, Moore, Cat. Lep. E. I. C., p. 174, t. v. *a*, fig. 5 ; Butt. Ind., ii., p. 178.

Found at the same elevation and seasons as the last. The females, which are rarer, resemble those of *A. inara* more than *zeroca* or *selenophora*, but there is some variation in the colour of the ferruginous bands, which are always paler than in *A. inara*, and sometimes whitish. The male is certainly distinguished from *selenophora* and *zeroca* by the rufous spot at the apex of fore wing, but the number of spots on the costal band is variable in all three species.

171. *Athyma inara.*

Limenitis inara, Doubl., Hew., Gen. Di. Lep., ii., t. xxxiv., fig. 3 (1850).

Athyma inara and *inarina*, Butt. Ind., ii., p. 179.

A. inarina, Butl., Ann. Nat. Hist., 1885, p. 30.

Though Mr. Butler has separated the species commonly known as *A. inara*, because it does not quite agree with the original description and figure, yet, as no specimen is known which does quite agree with that figure, it is reasonable to suppose that it is either incorrect or represents an aberration with wider bands than usual. I prefer therefore to retain the well-known name until it shall be shown that there is a difference of sufficient importance in nature to separate the species.

A Nepalese specimen in my collection differs from Sikkim ones in having the marginal markings on lower half of fore wing above whitish and not reddish. *A. asita*, Moore, from Moulmein and Tenasserim, is hardly separable from *inara*, though the submarginal band on hind wing above is narrower and sometimes white, or partly so.

A. inara is common at low elevations in Sikkim from March to December.

172. *Abrota ganga.*

Abrota ganga, Moore, Cat. Lep. E.I.C., i., p. 178, t. vi. *a*, fig. 1.

A. jumna, Moore, P.Z.S., 1865, p. 764; Butt. Ind., ii, t. xxiv., fig. 110, ♂ only.

A. mirus (Fab. *fide* Butler); Butt. Ind., ii., t. xxiv., fig. 110, ♀ only.

In this instance I have not followed de Nicéville's nomenclature, because I think it most unlikely that Fabricius ever could have seen the insect in question, which is confined to Sikkim, a country which in his time was almost unknown, and from which no insects are likely to have come. Mr. Butler's endeavours to identify Fabricius' descriptions are often of doubtful advantage to science, and the raking-up of old names for species well known under modern ones is a practice which cannot in such cases be defended.

I must also confess my inability to separate the two forms described as *A. ganga* and *A. jumna*, which do not seem to me to be constant. Moller and de Nicéville consider them distinct species, but do not know which of the female forms belong to the two male forms. Moller finds both at the same season.

A. ganga is not a common species; it seems peculiar

to the lower elevations of Sikkim, where it is found at 2—3000 ft. from May to August.

173. *Symphadra nais.*

Papilio nais, Forster, Nov. Spec. Ins., vol. i., p. 73 (1771).
P. thyelia, Fab., Ent. Syst., iii., p. 142 (1793).
Symphadra nais, Moore, Lep. Cey., i., p. 35; Butt. Ind., ii., p. 186.

Hardly a Sikkim insect, but may occur in the Terai, as there are two specimens from Sikkim in Major Marshall's collection.

Symphadra dirtæa may also occur in Sikkim, as it is found at Buxa in Bhotan, and is recorded from Nepal; but we have seen no Sikkim specimens.

? 174. *Euthalia iva.*

Adolias iva, Moore, Cat. Lep. E. I. C., p. 195; Butt. Ind., ii, p. 197.

The occurrence of this species is doubtful. The type in the late E. I. C. Museum is the only specimen I have seen, and there is no good authority for its habitat.

175. *Euthalia nara.*

Adolias nara, Moore, Trans. Ent. Soc. Lond, 1859, p. 78, t. viii., fig. 1, ♀.
Euthalia nara, Butt. Ind., ii., p. 197.

A species which seems to have become much rarer than formerly. I have never seen it in Sikkim, though I have taken it in Khasia at 4500 ft. in September. I imagine that, like the next two species, it is an inhabitant of that zone of forest between 3 and 5000 ft., which is now almost everywhere felled in British Sikkim; further east, at Buxa, it is not uncommon in the months of July and August.

176. *Euthalia sahadeva.*

Adolias sahadeva, Moore, Trans. Ent. Soc. Lond., 1859, p. 80, t. viii., fig. 3.
Euthalia sahadeva, Butt. Ind., ii., p. 199.

I may say very much the same of this species as of

the last, but it still occurs in Sikkim. I procured one or two males from natives in 1886. I have not seen the female.

177. *Euthalia durga.*

Adolias durga, Moore, Cat. Lep. E. I. C., p. 196 (1857), E.
Euthalia durga, Butt. Ind., ii., p. 199.

Not so rare as the last two species, but seldom found in late years. Moller's few specimens were taken in June, July, and August at about 3 to 5000 ft.

178. *Euthalia duda.*

Euthalia duda, Staud., Ex. Schmett., pt. i., p. 152, t. liii., (1886), ♂; de Nicé., P. Z. S., 1887, p. 455, ♀.

Two males of this species have been in my collection for some years, and I had described it for this paper when I found that it had already been made known by Dr. Staudinger and Mr. de Nicéville. It is quite distinct from, though nearly allied to, *E. durga*, the differences being noted below It must be very rare in Sikkim, as none have been obtained of late years by Moller or myself.

The band of the fore wing is differently shaped, having the first white spot on the costa almost obsolete, and not elongated inwards in a distinct white line, as in *durga*. The fourth patch is out of line with the others, the fifth, sixth, and those below it are much shorter, and not bordered outwardly with a bluish band, as in *durga*. On the hind wing the band is not outwardly bordered with a black line, as in *durga*, is shorter and directed more inwards, and, instead of a distinct bluish band extending beyond the white one to the anal angle, there is a fainter, more lilac, and less-defined band. On the under side the difference is less marked, but the shape and direction of the white bands are quite distinct, and the ground colour greenish rather than blue-grey, as in *durga*. The black external band on the fore wings of *susanus* is broader, more defined, and touches the lower part of the white band, which is not the case in *durga*. The size of my two specimens are nearly half-an-inch less in expanse than *durga*.

179. *Euthalia franciæ.*

Adolias franciæ, Gray, Lep. Nep., p. 12, t. xiv. (1846).
Euthalia franciæ, Butt. Ind., ii., p. 202.

A rare species in recent years in Sikkim, probably from the same causes as have been mentioned above. It probably occurs at the same elevations and seasons as the last. I have taken it near Cherra Punji, in the Khasia, in September, and find that the Khasia specimens can be distinguished from Sikkim ones by their narrower white bands.

180. *Euthalia phemius.*

Itanus phemius, Doubl., Hew., Gen. Di. Lep , ii., t. xli., fig. 4, ♂ (1850).
A. sancara, Moore, Cat. E. I. C., p. 195 (1857), ♀.
Euthalia phemius, Moore, Trans. Ent. Soc Lond., 1859, p. 65, t. iii., fig 3 ; Butt Ind., ii , p. 218.

A common species up to 3 or 4000 ft from April to December. With regard to the female of this insect, there is some question. De Nicéville seems positive that the insect described by Moore as *sancara*, of which no male is known, is the female of *phemius*, though the difference in the markings is certainly very great.

Moore, on the other hand, is equally sure that what de Nicéville thinks to be the female of *jama* is the true female of *phemius*, and the markings of this insect, of which I have seen two specimens only in his own and the British Museum collection, seem to favour this view. But as *phemius* the male sex, and *sancara* the female, are both common at similar elevations in Sikkim, whilst *jama* is so rare that I have only two old male examples from Wilson's collection and no females, I think de Nicéville's contention is probably correct, as there is, as far as I know, no single instance among the *Nymphalidæ* of the female sex being commoner than the male, and there is no other insect in Sikkim, except *phemius*, which I can suppose to be the male of Moore's *sancara* *

* Moller writes that he has seen the male *phemius* chasing what Moore calls *sancara*, whilst of the true *jama* ♀ (*phemius* ♀ apud Moore) he has never procured more than one specimen.

181. *Euthalia garuda.*

Adolias garuda, Moore, Cat. E I. C., p. 186, t. vi., figs. 2, 2*a* (1857); Trans Ent Soc. Lond., 1859, p. 64, t. iii, fig. 2 (1859); Butt. Ind., ii., p. 216.

Occurs in the outer hills and Terai up to 2000 ft. during the whole of the year.

182. *Euthalia jama.*

Adolias jama, Feld., Reise Nov., p. 431 (1866); Butt. Ind, ii., p. 219; Wood-Mason and de Nicé., J.A.S.B., 1887, p. 361, t. xvi., 4 ♂, 3 ♀.

I know nothing as to the occurrence or habits of this species in Sikkim, though Möller mentions it as being found rarely from 1 to 3000 ft. during the season. He has only three specimens in all, and I have two males which came out of Wilson's old Darjeeling collection.

183. *Euthalia lubentina.*

Papilio lubentina, Cram., Pap. Ex. ii., t. clv., C, D (1777)

Euthalia lubentina, Butt. Ind., ii., p. 220.

A fairly common species at low elevations from April to October.

184. *Euthalia lepidea.*

Adolias lepidea, Butl., Ann. Nat. Hist., 1868, i., p. 71.

A. cocytus, Moore (nec Fab.), Trans. Ent. Soc. Lond., 1859

Euthalia lepidea, Butt. Ind., ii., p. 203, t. xix., fig. 78, ♂.

Rare in the hottest valleys from March to November, but commoner in the Terai and eastward in Bhotan.

185. *Euthalia telchinia.*

Adolias telchinia, Men., Cat. Mus. Petr., ii., p. 120, t. ix., ♂ (1857).

A. aphidas, Hew., Ex. Butt., iii., Ad., t. ii., fig. 8, ♀.

Euthalia telchinia, Butt. Ind., ii., p. 206.

Rather rare in the valleys at 2—3000 ft. Occurs from April to October.

186. *Euthalia appiades.*

Adolias appiades, Men., Cat. Mus Petr., ii., p. 120, t. ix., fig. 4, ♂.
A. sedeva, Moore, Trans. Ent. Soc. Lond., 1859, p. 68, t. iv., fig. 3, ♀.
Euthalia appiades, Butt. Ind., ii., p. 201.

Common up to 3000 ft. from March to December.

187. *Euthalia jahnu.*

Adolias jahnu, Moore, Cat. Lep. E. I. C., p. 192, 1857; Trans Ent. Soc. Lond., 1859, p. 74, t. vii., fig. 1, ♀.
Euthalia jahnu, Butt. Ind., ii., p. 211; Wood-Mason & de Nicé., J. A. S. B., 1886, p. 360, t. xvi., 5, ♀.
Adolias sananda, Moore, Trans. Ent. Soc. Lond., 1859, p. 76, t. vii., fig. 3, ♂.

A rare species of late years, though de Nicéville has taken both sexes at low elevations in October.

188. *Euthalia kesava.*

Adolias kesava, Moore, Trans. Ent. Soc. Lond., 1859, p. 67, t. iii., fig. 5.
Euthalia kesava, Butt. Ind., ii., p. 212.

Common up to 2—3000 ft. from April to December. *Euthalia alpheda*, God., is recorded from Sikkim, but on no good authority, as far as I can discover, and neither Möller or myself have ever seen specimens.

189. *Euthalia anosia.*

Adolias anosia, Moore, Cat. E. I. C., p. 187 (1857).
Euthalia anosia, Butt. Ind., ii., p. 222; Dist., Rhop. Mal., p. 117, t. xiv., 5, ♀.

Very rare in Sikkim. Möller has a single male taken in October, and Mr. Feilmann took the female in April.

190. *Vanessa cardui.*

Papilio cardui, Linn., Syst. Nat., ed. x., p. 475.
Pyrameis cardui, Butt. Ind., ii., p. 227.

Occurs all the year round, but especially in winter, at

the lower elevations; on the higher ground up to 12,000 ft. or more in summer.

191. *Vanessa indica.*

Papilio indica, Herbst., Nat. Schm., vii., p. 171, t. clxxx. (1794).
Pyrameis indica, Butt. Ind., ii., p. 229, t. xviii., fig. 74.
P. callirhoe, Hübn., Verz. bek. Schmett., p. 33 (1816).

Not uncommon in open ground, like the last, at all seasons and elevations up to 12,000 ft.

192. *Vanessa canace.*

Papilio canace, Linn., Syst. Nat., xii., vol. i., p. 779 (1767).
P. charonia, Drury, Ill. Ex. Ent., i., t. xv., 1, 2 (1770).
Vanessa canace, Butt. Ind., ii., p. 231.

Occurs, but never commonly, up to 5 or 6000 ft. during the greater part of the year.

193. *Vanessa antiopa.*

Papilio antiopa, Linn., Syst. Nat., x., p. 476 (1758).
Vanessa antiopa, Butt. Ind., ii., p. 232.

I have no knowledge of the occurrence of this in Sikkim proper, though I received a considerable number from native collectors, which were taken in Chumbi or Bhotan in July and August. I am not aware that it has been taken in any other part of the Himalaya.

194. *Vanessa kashmirensis.*

Vanessa kaschmirensis, Koll., Hugel's Kash., iv, p. 442, t. xi., figs. 3, 4 (1848) : Butt. Ind., ii., p. 233.

Occurs from 2 or 3 up to 12,000 ft. and upwards; commoner at low elevations in winter. I have formerly remarked that Sikkim specimens were darker than those from Kashmir, but I do not now think that they could be distinguished, as the colour varies in Sikkim as in the North-west Himalaya. Though very near to *V. urticæ*, which occurs in Northern, Western, and Central Asia, I have specimens from Asia Minor, North Persia, Namagan, Amurland, and Japan; it is, I think, always

distinct on account of the colour of the fore wing below, and Doherty says the claspers are different from those of *V. urticæ.*

? 195. *Vanessa rizana.*

Vanessa vizana, Moore, P. Z. S., 1872, p. 559; Butt. Ind., ii., p. 234.

I hardly know whether to keep this species distinct from *urticæ.* It agrees very well with that species in the colour of the upper side, but on the under side has none of the yellowish colour on the fore wing shown by all my specimens of *urticæ,* excepting one sent by Dr. Staudinger as "var. *Turanica*" from Namagan, which is intermediate in this respect. I have several specimens of *rizana,* viz., two from Kashmir, one of which was named by Moore; four from Lahoul; and three from Ta-tsien-lo, in East Tibet, where it is a common and constant form, judging from the specimens in M. Oberthur's collection. I include this species doubtfully in the Sikkim fauna on the strength of a bad specimen received through native collectors from the interior.

196. *Vanessa ladakensis.*

Vanessa Ladakensis, Moore, Ann. Nat. Hist,, 1878, i., p. 227; Butt. Ind., ii., p. 234.
V. Ladakensis, Elwes, P. Z. S., 1882, p. 403.

I have nothing to add to what I wrote about this species, which I have only received from the eastern frontier in Chumbi or Bhotan. It is more distinct than either *kashmirensis* or *rizana.*

197. *Vanessa c-album,* var. *tibetana,* new var. (Pl. X., fig. 1).

Vanessa c-album, Linn.; Butt. Ind., ii., p. 237; Elwes, P. Z. S., 1882, p. 403.

When previously writing of this species I had but one specimen from Sikkim, which I could not identify with *V. agnicula,* Moore, or separate from *c-album.* Since then I have received many more from the same source *viz.,* native collectors in Chumbi and North-west Bhotan. Twelve fresh ones now in my collection differ so conspicuously from all others which I have, *viz.,* 40 from various parts of Europe, 6 from Turkestan (var.

intermedia, Stgr.), 4 from Japan, and 15 from the North-west Himalaya, that I think they must bear a distinctive name. The only ones which approach them in coloration on the upper side are two from Lahoul, but these could easily be distinguished, though they differ more on the under side.

This variety may be distinguished by the bright reddish colour of the wings above and the absence of any yellowish spots on the dark border of the hind wing, which are seen in all my North-western and Turkestan specimens. On the under side there are two types of coloration, the mottled one with complete C mark, and the dull brownish one with straight or imperfect C mark, both of which are seen in European *c-album*. The North-western specimens from several localities vary both on the upper and under sides even more than European ones, four from Kashmir being hardly, if at all, distinguishable from *c-album*, while others, one of which is named *agnicula* by Moore, are slightly different from the common type, and two from Lahoul approach the Sikkim form. These fifteen specimens vary extremely on the under side, having, in addition to the three typical forms in Europe, at least two other forms of coloration. Before *agnicula* can be separated from *c-album*, it must be defined, and that seems to me at present impossible.*

198. *Symbrenthia hippoclus*.

Papilio hippoclus, Cram., Pap. Ex., iii., p. 46, t. ccxx. C, D (1779).

Symbrenthia hippoclus, Butt. Ind., ii., p. 240.

Common up to about 6000 ft. more or less all the year round.

199. *Symbrenthia hypselis*, Godt.

Vanessa hypselis, Godt., Enc. Meth., ix., Suppl., p. 818 (1823).

Symbrenthia hypselis, Butt. Ind., ii., p. 241.

Common at elevations up to about 4000 ft. during most of the year. It seems a very variable species, and

* Since writing the above I have seen other specimens from Ta-tsien-lo, in East Tibet, which agree perfectly with mine.

several forms have been separated by Moore, which may not be really distinct. One of them is—

S. cotanda, Moore, P. Z. S., 1874, p. 569, t. lxvi., fig. 9, ♂; Butt. Ind., ii., p. 242.—I have seen nothing from Sikkim, whence the type came, which quite resembles the plate, and agree with de Nicéville that it is hardly a good species.

200. *Symbrenthia niphanda.*

Symbrenthia niphanda, Moore, P. Z. S., 1872, p. 559; Butt. Ind., ii., p. 243

This is rare at low elevations, about 3 to 5000 ft. from March to October, and seems quite distinct from *hypselis*, as well as from *silana*. On the upper side, however, it most resembles *hippoclus*.

201. *Symbrenthia silana.*

Symbrenthia silana, de Nicé., J. A. S. B., 1885, pt. ii., p. 117, t. ii, fig. 9, ♂; Butt. Ind., ii., p. 243.

This is also rare and local at about 2000 ft. elevation, where Möller has hitherto only procured it in May. It is easily distinguished by the broad pale fawn-coloured bands. It has also been taken at Buxa. The females in these two last species resemble the males more closely than is the case with *S. hippoclus* and *S. hypselis*.

202. *Cyrestis cocles.*

Papilio cocles, Fabr., Mant. Ins., ii., p. 7 (1787); Don., Ins. Ind., t. xxiii., 2 (1800).
Cyrestis cocles, Butt. Ind., ii., p. 254.

A single male of this species was taken in the spring of 1887 by Möller's men at low elevation, the first, as far as I know, which has been recorded from Sikkim.

203. *Cyrestis thyodamas.*

Cyrestis thyodamas, Boisd., Cuv. Reg. An. In, vol. ii., t. cxxxviii., fig. 4 (1836); Butt. Ind., ii., p. 251.
Amathusia ganescha, Koll., Hugel's Kash., p. 430, t. vii., 3, 4 (1848).

Common up to about 6000 ft. from March to December.

204. *Cyrestis risa.*

Cyrestis risa, Doubl., Hew., Gen. Di. Lep., ii., p. 262, t. xxxi., 4 (1850); Butt. Ind., ii., p. 256.

Less common than the last, and not extending so high up; April to October.

205. *Kallima inachus.*

Paphia inachus, Boisd., Cuv. Reg. An., ii., t. cxxx, ix., 3, ♀ (1836).
Kallima inachis, Moore, Trans. Ent. Soc. Lond., 1879, p. 11; Butt. Ind., ii., p. 261.
K. boisduvali, Moore, *l. c.*, p. 12; Butt. Ind., ii., p. 262.
K. atkinsoni, Moore, *l. c.*, p. 10.
K. Ramsayi, Moore, *l. c.*, p. 12.

I do not see how more than one species of *Kallima* can be distinguished in Sikkim, though three have been separated by Moore, as well as others from Nepal and the North-west, only one of which, *K. hügeli*, Koll., seems to me a good species.

It is common in Sikkim up to about 5000 ft. from March to November, and varies much both in the extent to which the apex of the wing is prolonged and in the colour of the under side. This insect has been specially noticed by Wallace and later writers as an instance of protective resemblance to dead leaves, and this is, no doubt, very striking when settled with the wings closed; but this is not the universal habit of the butterfly, which I have sometimes seen settled on a branch with the wings open, when it is a very conspicuous object.

206. *Doleschallia polibete.*

Papilio polibete, Cram., Pap. Ex., iii., t. ccxxxiv., D, E (1779).
Doleschallia bisaltide, Moore (nec Cram.), P. Z. S., 1865, p. 767.
D. polibete, Butt. Ind., ii., p. 268, t. xxiii., fig. 103, ♂.

A common species up to about 4000 ft. from April to December. It settles on rocks and banks of earth with wings closed, when it is hard to see, but not shy.

The under side of this species varies very much in the same style of coloration as *Kallima inachus*; the prolonged hind wings also resemble a leaf-stalk when

the wings are closed, but if the habit of settling on the ground is the usual one, this protective resemblance does not seem to be of much use.

207. *Charaxes dolon.*

Charaxes dolon, Westw., Cat. Or. Ent., p. 55, t. xxvii., 2, 3 (1848); Butt. Ind., ii., p. 272, t. xxii., fig. 100, ♂.

A rare species at 3—4000 ft. in Sikkim, where Möller has only obtained it in April and May.

208. *Charaxes eudamippus.*

Charaxes eudamippus, Doubl., Ann. Soc. Ent. France, 1843, p. 218, t. viii.; Butt. Ind., ii., p. 273.

Common at low elevations from April till August.

209. *Charaxes athamas.*

Papilio athamas, Drury, Ill. Ex. Ent., i., p. 5, t. ii. (1770).
Charaxes athamas, Butt. Ind., ii., p. 275.
C. samatha, Moore, P. Z. S., 1878, p. 831.
Eulepis hamasta, Moore, *l. c.*, 1882, p. 238.
Charaxes bharata, Feld., Reise Nov., iii, p. 438 (1867).

This wide-ranging and variable species has received two most objectionable synonyms from Moore in addition to Felder's. Why names which have no apparent meaning, and are therefore hard to remember, should be made additionally senseless by transliteration is one of those points which, though often criticised, Mr. Moore does not condescend to explain. I have seen his type of *hamasta*, and have Ceylon specimens (*samatha*). In neither is there anything at all to make them worthy of distinction even as varieties. The species is common in Sikkim at low elevations from April to December, and occurs up to 5 or 6000 ft.

I entirely agree with the conclusion come to by de Nicéville after a most careful examination of numerous specimens from all parts of India, namely, that "there is but one species, *C. athamas*, which is variable in all the characters which have been taken by different writers in describing the many species which are said to be allied to, but distinct from, the parent species, and

that these variations are not confined to any particular geographical ranges of country, nor are they constant."

210. *Charaxes arja.*

Charaxes arja, Feld., Reise Nov., iii., p. 438 (1867); Butt. Ind., ii., p. 278.

This species, which de Nicéville thinks may be identified with Felder's *arja*, and which is distinguished from the last by the whitish colour of the discal band, is rare in the lower valleys at the same season as the last.

211. *Charaxes fabius.*

Papilio fabius, Fabr., Sp. Ins., ii., p. 12 (1781).
Charaxes fabius, Butt. Ind., ii., p. 280.

Rather an insect of the plains than the hills, but occurs sometimes in the Terai and low valleys in May, June, and July.

212. *Charaxes marmax.*

Charaxes marmax, Westw., Cat. Or. Ent., p. 43, t. xxi. (1848); Butt. Ind., ii., p. 281.

Occurs commonly up to about 3000 ft. from April to October.

213. *Charaxes lunawara.*

Charaxes lunawara, Butl., Lep. Exot., p. 99, t. xxxvii., 2, ♂ ♀ (1872); Butt. Ind., ii., p. 282.

214. *Charaxes aristogeton.*

Charaxes aristogeton, Feld., Reise Nov., iii., p. 445; Butt. Ind., ii., p. 282.

These two species are both very nearly allied to *marmax*. I should hardly have considered them distinct species, but Möller, who has taken many of both, says that he can always separate the three species without difficulty.

Lunawara is best distinguished by the more conspicuous markings of the under side, and *aristogeton* by the broader border of the fore wing and darker colour of the under side.

215. *Charaxes hierax.*

Charaxes hierax, Feld., Reise Nov., iii., p. 442; Butt. Ind., ii., p. 290 (1867).
? *C. bernardus*, Fabr. apud Koll., Hugel's Kash., p. 434, t. xi.

This species, which is probably only a form of *bernardus*, is rare in Sikkim, and occurs in the lowest valleys only, where Moller has procured it in May. It has the darkest under side of any of those found in Sikkim.

216. *Charaxes pleistoanax.*

Charaxes pleistoanax, Feld., Reise Nov., iii., p. 443 (1867); Butt. Ind., ii., p. 292.
C. hindia, Butl., Lep. Ex., p. 99, t. xxxvii., 5, ♂ ♀ (1872); Butt. Ind., ii., p. 291.

This, which is very close to, if not identical with, the white-banded species described by Cramer as *polyxena*, is common up to 3000 ft. from April to October, and by Moller and de Nicéville is divided into two species.

C. Jalinder, Butl., is also said to occur in Sikkim, but, as I am not able to discover any constant characters by which these three may be distinguished or separated, I keep them as one.

I think that when a large number of specimens of these tawny *Charaxes* from different localities are compared, it will be impossible to keep apart even so many as five species.

LEMONIIDÆ.

LYBITHÆINÆ.

217. *Libythea myrrha.*

Libythea myrrha, God., Ency. Meth., ix., p. 171 (1819); Butt. Ind., ii., p. 302.

Not uncommon at low elevations from April to October.

218. *Libythea lepita.*

Libythea lepita, Moore, Cat. E. I. C., p. 240 (1857); Butt. Ind., ii., p. 303.

Rather commoner than the last at similar elevation and season.

NEMEOBIINÆ.

219. *Zemeros flegyas.*

Papilio flegyas, Cram., Pap. Ex., iii., t. cclxxx., E, F (1780); Butt. Ind., ii., p. 308.

An abundant species in Sikkim, as elsewhere; most numerous in bushy ground or low jungle, and occurring up to 5 or 6000 ft. from March to December. It is very difficult to get examples of this species in a perfectly fresh condition, as the wings seem to get rubbed almost as soon as they begin to fly.

220. *Dodona dipæa.*

Dodona dipæa, Hew., Ex. Butt., iii., t. i., fig. 3 (1866); Butt. Ind., ii., p. 311, t. xxiv., fig. 116, ♂.

Perhaps the commonest species of the genus in Sikkim, where it occurs most abundantly in the forest at 6—7000 ft. in the rainy season, but goes up as high as 9 or 10,000 ft., and is out from April to November or December, but most abundant in autumn. The females, as in other species of the genus, are much rarer than the males.

221. *Dodona eugenes.*

Dodona eugenes, Bates, Journ. Linn. Soc., Zool., ix., p. 371 (1867); Butt. Ind., ii., p. 315.

Much rarer than the last, from which it is easily distinguished by its tailed hind wings, but found at the same elevation.

222. *Dodona ouida.*

Dodona ouida, Moore, P. Z. S., 1865, p. 771; Butt. Ind., ii., p. 311.

According to Möller this has a very wide range in Sikkim from 3 to 10,000 ft., but I have only seen it myself at about 5 to 7000 ft., where it frequents more open places than *dipæa*, settling with open wings on branches of trees, and flying back to the same perch when disturbed.

The female, which is much larger, has a single broad white band on the fore wing instead of three fulvous ones.

223. *Dodona egeon.*

Taxila egeon, Doubl., Hew., Gen. Di. Lep., ii., p. 422, t. lxix., fig. 2 (1851); Butt. Ind., ii., p. 314.

A very rare species in Sikkim, from whence I have only a single ragged pair, but seems commoner in Nepal. Möller has only once procured it at about 1000 ft. elevation in May.

224. *Dodona adonira.*

Dodona adonira, Hew., Ex. Butt., iii., Dod., t. i., figs. 1, 2, ♂ (1866); Butt. Ind., ii., p. 312.

Another rare species, which occurs on paths in dense forest at 7—9000 ft. in the rainy season. I have only once taken it myself. It flies fast and settles on the ground.

225. *Abisara fylla.*

Taxila fylla, Doubl., Hew., Gen. Di. Lep., ii., p. 422, t. lxix., fig. 3, ♂ (1851).
Abisara fylla, Butt. Ind., ii., p. 321.

Not uncommon up to 4 or 5000 ft. from March to November.

226. *Abisara neophron.*

Sospita neophron, Hew., Ex. Butt., ii., Sosp., t. i., fig. 3 (1861).
Abisara neophron, Butt. Ind., ii., p. 321.

Not uncommon at 2 to 4000 ft. from March to November.

227. *Abisara chela.*

Abisara chela, de Nicé., J. A. S. B., 1886, p. 252, t. xi., fig. 7, ♂; Butt. Ind., ii., p. 322.

Rarer than the last, from which it is quite distinct, and found at the same seasons and elevation.

LYCÆNIDÆ.

228. *Poritia hewitsoni.*

Poritia Hewitsoni, Moore, P. Z. S., 1865, p. 775, t. xli., fig. 10.

Not uncommon up to 3000 ft. from April to December.

Curetis thetys.

Anops thetys, Drury, Ill. Ins., iii., figs. 3, 4 (1773).
? *A. stigmata*, Moore, P. Z. S , 1879, p. 138.

Moller notes this as a common species up to 3000 ft. from March to November, but the only one I have seen which can be assigned to *thetys* is a rufous, not grey, female marked *gloriosa* ♀ by Moore, and labelled by him "Darjeeling, Grote." I have similar ones from Barrackpore only, and think it much more likely that the locality of Grote's specimen is an error, and that Möller's supposed *thetys* is one of the forms of *bulis*.

229. *Curetis bulis.*

Anops bulis, Westw. & Hew., Di. Lep., t. 75, fig. 5.
? *Curetis dentata*, Moore, P. Z. S., 1879, p. 137.
? *C. discalis*, Moore, *l. c.*, p. 138.
? *C. angulata*, Moore, *l. c.*, 1883, p. 522, t. 48, fig. 1.

An extremely variable species which has received many names from Moore, who divides it on account of the varied shape of the wings and the colouring of the upper side. I have about fourteen males and nine females from Sikkim, three males and a female from Buxa, two males and a female from Mandi, and a male and female from Kangra, the latter marked *dentata* by Moore, though, if I am not mistaken, the female belongs to *C. thetys*. Möller thinks he can distinguish three species in Sikkim of this group, which have on the under side in both sexes, and in both wings, but most conspicuous in the hind wing, a bar of raised silvery scales across the cell, represented on the upper side by a more or less conspicuous black mark. But when I try to divide these specimens into two or three species, which at first would seem to be possible, I find intermediate examples which are neither of one or the other. The form *angulata* seems very distinct from some which have the hind wings shaped as in *C. thetys*, but there is no constancy in this character.

230. *Loxura atymnus.*

Papilio atymnus, Cram., Pap. Ex., iv., t. cccxxxi., D, E (1780).

Common up to 5000 ft. from March to December. I found it most abundant in the Tista Valley in August.

231. *Loxura tripunctata.*

Loxura tripunctata, Hew., Westw. & Hew., Di. Lep., t. 74, fig. 2.

Much rarer than the last, from the Terai up to about 3000 ft. from May to October. I have it also from Aracan, taken in February.

232. *Liphyra brassolis.*

Liphyra brassolis, Westw., Proc. Ent. Soc. Lond., 1864, p. 31.
Sterosis robusta, Feld , Reise Nov., ii., p. 219, t. 27, figs. 10, 11 (1865).

This is one of the rarest and most remarkable insects in Sikkim, and I have only seen five specimens in all, of which two formerly in Wilson's collection are now in Mr. Godman's, one, the type, in Hewitson's collection, and two in Möller's. Of its habits and locality I can obtain no certain information, though Möller's specimens were said to have been taken at 6—8000 ft.; but it seems to be very widely distributed in the Malayan region, though everywhere rare.

233. *Gerydus drumila.*

Miletus drumila, Moore, P. Z. S., 1865, p. 777, t. xli., fig. 12, ♀.
? *Gerydus drumila*, Moore, P. Z. S., 1883, p. 521, ♂.

This is also a very rare species, which occurs at about 2000 ft. in March, April, and May, as far as we know at present. It is a very remarkable insect in its appearance. The hooked hind margin of the fore wing in both sexes distinguish this species from the next.

234. *Allotinus multistrigatus.*

Allotinus multistrigatus, de Nicé., J. A. S. B., 1886, p. 253, t. xi., fig. 11, ♂, 2 ♀; Doherty, *l. c.*, p. 131.

This species, though structurally different, according to Mr. Doherty, from the last, is very like it in general

appearance, and I had some difficulty in knowing whether Moore's description of the male of *drumila* does not apply to *multistrigatus*. The position of the third costal nervule and the shape of the hind margin of the fore wing distinguish them.

This species is rare at the same elevation and season as the last. I found it at Cherra Punji, in the Khasia Hills, in open places of the forest, settling on bushes.

235. *Miletus boisduvalii.*

Miletus boisduvalii, Moore, Cat. Lep. E. I. C., p. 19, t. i. *a*, fig. 1 (1857); Doherty, J. A. S. B., 1886, p. 132.

Not an uncommon species in the low valleys, where I have taken it at 2—3000 ft. in July. It occurs from April to October, and is somewhat variable in size.

? 236. *Miletus Horsfeldi.* ?

Miletus Horsfeldi, Moore, Cat. E. I. C., p. 9, t. i. *a*, fig. 2.

Paragerydus Horsfeldi, Dist., Rhop. Mal., p. 207, t. xx., fig. 7, ♀.

I have a single specimen of a very small insect allied to *Miletus boisduvalii*, which came either out of Mandelli's or Wilson's Sikkim collections. It agrees fairly with specimens under this name in the British Museum, but is smaller and paler in colour below than either Moore's or Distant's figures. I do not, however, feel justified in separating it on a single specimen of doubtful locality.

237. *Neopithecops hamada ?.*

Miletus hamada, Druce, Cist. Ent., i., p. 361 (1875); Doherty, J. A. S. B., 1886, p. 132.

I am in doubt both as to the genus in which to place this species, and also as to whether it should be separated from the Japanese insect described by Druce. Superficially the insect is, according to Doherty, much nearer the *Lycænina*, with which he says the structure of the prehensors agree, but its palpi and antennæ are nearer to those of *Gerydus*. Mr. Butler considers it to

belong to the genus *Neopithecops*, and places it next to *N. zalmora* in the British Museum collection.

As regards its identity with *hamada*, I have six specimens from Sikkim, three from Shillong, six from Japan; the latter are all plain dark brown above, whilst all the Indian specimens have a larger or smaller white patch on the fore wing. The fringes, antennæ, and markings of the under side agree very well. A specimen from Tenasserim in the British Museum agrees with the Sikkim form.

I have taken this insect at about 5000 ft. in July, and, according to Moller, it occurs at low elevations from April to October.

238. *Neopithecops zalmora.*

Pithecops zalmora, Butl., Cat. Fabr., p. 161 (1870).
Parapithecops gaura, Moore, J. A. S. B., 1884, p. 5.
Neopithecops horsfeldi, Dist., Rhop. Mal., p. 209, t. xxii., 15, ♂.
Pithecops dharma, Moore, Lep. Cey., i., p. 72 (1881).

I can see no difference either in the neuration or markings between the insect found in Sikkim and a specimen from Padang, in Sumatra, which I believe to be *zalmora* of Butler; another from Kankaret, in Burmah, agrees with both.

Those I have from Calcutta have a white patch on fore and hind wings, which is variable, according to de Nicéville, though used to distinguish the form named *gaura* by Moore. *Horsfeldi*, Dist., from Singapore, and *Dharma*, Moore, from Ceylon, are both so nearly allied that the incomplete and indifferent figures and descriptions given by their authors are of no use in distinguishing between the species of this difficult group, if, indeed, they are possible to distinguish. And, as I agree with de Nicéville in thinking that they are all one species, I leave it to their authors to show the contrary.

It is common in Sikkim at low elevations from May to October.

239. *Megisba malaya.*

Lycæna malaya, Horsf., Cat E. I. C, p. 70 (1828).
Pathalia albidisca, Moore, J. A. S. B, 1884, p. 6.

Pathalia ? malaya, W. M. & de Nicé., J. A. S. B., 1886, p. 364.

Megisba Thwaitesi, Moore, Lep. Cey., p. 71, t. 34, figs. 3, 3*a*, ♂, 6, 6*a*, ♀.

M. sikkima, Moore, J. A. S. B., 1884, p. 6.

This species is found in the lower valleys from April to November, and in the form described by Moore as *P. albidisca* is not uncommon. In the form described as *Megisba sikkima* it is rarer. I have some difficulty in deciding as whether to treat these two forms as distinct species, and, judging by the Sikkim specimens alone, should be inclined to do so, though I cannot for a moment allow that either of the Sikkim forms are separable from those found in other parts of India under the names of *P. malaya* and *M. Thwaitesi*.

The differences noted by Moore are inconstant, and the generic difference between *Pathalia* and *Megisba*, namely, the presence of a caudal appendage, is certainly not constant even in the same species. The amount of white on the upper side is very variable, but the under sides seem to separate the insects found in Sikkim into two groups, though a specimen taken by myself at Khandalla, in the Western Ghats, and marked *M. Thwaitesi* by Moore himself, is intermediate between the two.

De Nicéville's remarks on the species referred to above should be studied, and his opinion is that all the three forms described by Moore are identical with the one variable tailed or tailless species found in the N. E. Himalaya, and which we believe to be a form of *Lycæna malaya* of Horsfeld, which is from Java and Sumatra. I have a specimen from Mr. Moore marked by him *Neopithecops todara*, Moore, which also appears to me to belong to this species, though the upper side has more the aspect of *N. zalmora*.

Doherty says of this species, in J. A. S. B., 1886, p. 134 :—" All my Kumaon specimens are tailed, as well as those taken in Burmah and Chittagong, while in Orissa, Ceylon, and the Eastern and Western Ghats, their place seems to be taken by a tailless form. Of this last those from Ceylon and the Western Ghats are apparently *Megisba Thwaitesi*, but those from Orissa and the Eastern Ghats seem to me identical with *malaya*,

except in the absence of a tail. The occurrence likewise of the tailless form of *Nacaduba ardates* in those districts is worthy of remark."

240. *Spalgis epius.*

Lucia epius, Westw., Gen. Di. Lep., p. 502, t. 76, f. 5, ♀ (1852).

Spalgis epius, Moore, Lep. Cey., p. 71, t 34, figs. 1, 1 *a*, *b*.

Found in the lower valleys, but not common, between the months of May and October.

241. *Cyaniris puspa.*

Polyommatus puspa, Horsf., Cat. Lep. E. I. C., p. 67 (1828).

This species is variable on both surfaces, but, as restricted by de Nicéville and Moore, is perhaps the commonest at low elevations, and distinguished by the darker, more numerous and irregular markings of the under side. Moller notes it as found from 1 up to 10,000 ft. It has a wide range in India.

Mr. Moller writes, in May, 1886:—"I have, during the month of March last, received specimens of the above species of this group, viz., *C. albocæruleus*, *transpectus*, *marginata*, *placida*, *dilectus*, *jynteana*, and *puspa*, and am perfectly satisfied that they are all good and distinct species. *C. transpectus*, *marginata*, and *puspa* vary a good deal according to season, the broods occurring during the rainy season having a broader dark margin to both the wings, and all the spots on the under side better developed, whilst specimens taken in spring and autumn are characterised by a paler coloration and diffused patches of white on both wings."

242. *Cyaniris marginata.*

Cyaniris marginata, de Nicé., J. A. S. B., March 6th, 1883, p. 70, t. i., fig. 9, ♂; Moore, P. Z. S., April 1st, 1883, p. 523, t. 48, fig. 6; Doherty, J. A S. B., 1886, p. 134, ♀.

I was inclined to unite this form also with *C. puspa*, as the broad dark margin, which is supposed to distinguish it, is a variable character. Doherty, however,

who describes the female from Kumaon, says that it is distinguished from *puspa* by the shape of the prehensors. He found it from 7 to 10,000 ft., whilst in the same region *puspa* was only taken below 7000 ft.

243. *Cyaniris albocæruleus.*

Polyommatus albocæruleus, Moore, P. Z. S., 1879, p. 139.
Cyaniris albocæruleus, de Nicé., J. A. S. B., 1883, p. 71, t. i., fig. 4, ♂, 4*a*, ♀.

This very beautiful form occurs both at Simla, Khatmandu, and in Sikkim, whence I have a male taken in December and females in January and August. I found it in the dense virgin forest at 6000 ft., but it occurs at from 2 to 8000 ft., according to Moller, all through the season. Doherty found it rare in Kumaon at 7000 ft.

244. *Cyaniris transpectus.*

Polyommatus transpectus, Moore, P. Z. S., 1879, p. 139.
Cyaniris transpectus, de Nicé., *l. c.*, p. 70, t. i., fig. 6, ♂, 6*a*, ♀.
? *C. latimargo*, Moore, P. Z. S., 1883, p. 523, t. 48, fig. 9.

This seems, by the form of the wings, more nearly related to *C. puspa*, and I have intermediate forms which seem to connect it with that species. The females are very variable. According to Möller it occurs at 1—9000 ft. elevation from April to November. The figure of *latimargo* shows no characters which can be relied on.

A form of this species, which Möller considers to be the cold-weather brood, has the border of the hind wings in typical examples completely wanting, and the centre of the wings much paler in colour. The markings below are, with the exception of the conspicuous black spot on the costal margin of the hind wing, almost obsolete.

245. *Cyaniris placida.*

Cyaniris placida, de Nicé., J. A. S. B., 1883, p. 68, t. i., fig. 8, ♂; Moore, P. Z. S., 1883, p. 523, t. 48, fig. 4.

This seems fairly constant as regards the male, which I have taken at 3—5000 ft. in May, June, and August.

The female was not known by de Nicéville when he described the species, and I am only able to guess whether what I have placed with it is really the female of this or another form; the under side, however, agrees.

246. *Cyaniris dilectus.*

Polyommatus dilectus, Moore, P. Z. S., 1879, p. 139.
Cyaniris dilectus, de Nicé., J. A. S. B., 1883, p. 68, t. i., fig. 5, ♂.

The male of this also is easy to separate, but the same difficulty arises as to its female, though I believe what de Nicéville has assigned to it is correct. I got this form from the interior with my Chumbi collection, and have it also from Shillong in the Khasias. Doherty found it in Kumaon at from 2 to 7000 ft., whilst Moller gives its range up to 9000 ft.

247. *Cyaniris jynteana.*[1]

Cyaniris jynteana, de Nicé., *l. c.*, p. 69, t. i., figs. 7, ♂, 7*a*, ♀; Moore, P. Z. S., 1883, p. 524, t. 48, fig. 10.
? *C. sikkima*, Moore, P. Z. S., 1883, p. 524, t. 48, fig. 8.

This is common at 4—6000 ft. in the Khasias, and also occurs in Sikkim at 2—9000 ft. most commonly in the rains; but I have a female specimen taken in January, and males taken at Shillong in May and September do not differ in any way from those taken in August in Sikkim. I cannot separate the specimen described as *sikkima* either by the description or figure; the blackish disco-cellular streak is a very variable character as far as I have seen, but the figure represents no specimen that I have seen, exactly.

248. *Zizera trochilus.*

Lycæna trochylus, Frey., n. Beit., p. 440, 1, v., p. 98 (Aug., 1844); Herr.-Schaff., t. 224—6.
L. putli, Koll., Hugel's Kash., p. 422 (1848).

Has been taken in the Terai and outer hills only in the winter months, and is hardly an inhabitant of Sikkim proper.

I should hardly have ventured to unite the Indian with the Western form but for the assurance of Mr. de Nicéville that he has every gradation between the two.

? 249. *Zizera pygmæa.*

Lycæna pygmæa, Snell., Tijdschr. Ent., xix., t. vii., fig. 8 (1876).

Möller includes this species as one taken formerly by him in the Terai, but I have seen no specimens that I can identify with it.*

250. *Zizera sangra.*

Polyommatus sangra, Moore, P. Z. S., 1865, p. 772, t. 41, 8.

Lycæna indica, Murray, Trans. Ent. Soc. Lond., 1854, p. 525.

This species is so close to *L. lysimon* of Hübner that I have great doubts about separating it, but the specimens I have from Sumatra, the Andamans, Calcutta, Buxa, and Sikkim seem to be of a paler blue above with a narrower dark border than my series of *lysimon* from Algeria, Andalusia, and the Canary Islands. What is usually called *L. indica*, which I have from Ceylon, Central India, Bombay, and the N.W. Himalaya, are so close that I cannot certainly distinguish them from *sangra*, though, as a rule, the markings below are more distinct, and the spots on the fore wing below larger. The species occurs in the Terai and outer hills in the cold weather, and I have taken it in the Tista Valley in August, but it is rare in the interior of the hills.

251. *Lycæna (Zizera) maha.*

? *Lycæna otis*, Fabr., Mant. Ins , ii., p. 73 ; Butl., Cat. Fabr., t ii , fig 8 (1870).

L. maha, Koll , Hugel's Kash , p. 422 (1848).

L. argia, Men., Cat. Mus. Petr , 125, t. x., fig. 7 (1857).

L. japonica, Murr , Ent. Mo. Mag , xi., p 167 (1874).

L. diluta, Feld., Reise Nov. Lep., ii., p. 280, t. 35, figs. 62, 13 (1865).

L similis, Moore.

Zizera, sp. nova, Moore MSS., ex. coll. Elwes.

If my series of this species was not a very large one (85 specimens), I should feel hardly justified in uniting so many supposed species, but I see no way by which they can be separated with certainty.

* Mr. de Niceville writes to me that this species is identical with *L. Gaika*, Trim., of South Africa.

From Japan I have five pairs, among which two males have moderate black borders, as in the autumn brood of the N.W. Himalayas; one has a moderate border, as in some Sikkim specimens taken in December; and two males have no border at all. Three of the females are dark, as in the summer broods of the N.W. and Sikkim Himalayas, and the other two with bluish shading on both wings. Three pairs from China are very similar to the first-mentioned Japanese, but smaller in size. Four pairs taken by me in Sikkim in December, one of which is marked "n. sp." by Moore, are all much paler in tint than three pairs taken in Sikkim in May and June; the border of the males is almost obsolete in three out of four. The December females are all marked with blue, whilst the June ones are plain dark brown. I have some specimens from the North-west Himalayas which agree with both the summer and winter forms in Sikkim, but the distinctions do not seem so well-marked. From Calcutta I have one pair, *diluta*, Feld., of de Nicéville's list, which agrees very well with Kangra and Sikkim specimens, also three pairs taken by myself at Shillong in September, and two pairs from Cachar in June and August, which are like the Sikkim summer brood, though rather smaller. From the Nilgiri and Arnamallay hills I have four males and two females, which resemble the Sikkim winter brood. From Poona four males and one female, marked *Z. ossa* by Swinhoe, which are like the smallest of the Sikkim winter brood, and one female from Indore taken by myself in November, which is also very small. The shade of blue of these South and Western Indian specimens is perhaps rather more grey and lighter than in the average of Himalayan specimens, and the markings of the under side in these and in the winter Sikkim brood are less distinct, and the black spots much fainter than in the summer brood.

252. *Lycæna Theophrastus.*

Hesperia Theophrastus, Fabr., Ent. Syst., iii., 1, p. 281 (1793).

Lycæna nara, Koll., Hugel's Kash., iv., 2, p. 421 (1848).

I have no specimens of this common plains' insect

from Sikkim, but Möller notes it from the Terai. After comparing a long series, *viz.*, three pairs from Algeria, one from Bushire, two from Karachi, ten from the N.W. Himalaya, two from Malabar and one from Tonghoo, and one from Bombay, I do not see how to distinguish *nara* from *Theophrastus*, though there is much variation in the different specimens.

253. *Lycæna plinius.*

Hesperia plinius, Fabr., Ent. Syst., iii., 1, p. 284 (1793).

This, like the last, is hardly an insect of the Sikkim hills, as it belongs to the dryer and hotter parts of India; but Möller notes it as occurring in the Terai.

254. *Lycæna bætica.*

Papilio bæticus, Linn., Syst. Nat., xii., 1, pt. 2, p. 789 (1767).

Not common in Sikkim, where the climate is too wet for it, but occurs up to 10,000 ft., and is commoner in the interior towards Bhutan, whence my native collectors have brought it.

255. *Lycæna pheretes*, var. *asiatica.*

Lycæna pheretes, Hb., var. *asiatica*, Elwes, P. Z. S., 1882, p. 402.

Since writing the above description I have received no more of this form from Sikkim, but have three specimens agreeing with them from Ladak, and also three pairs from Mongolia and Turkestan, which are like the European insect. These confirm my opinion that the Himalayan form of *pheretes* is distinguishable from others by its more pointed fore wings and a somewhat deeper shade of blue.

256. *Lycæna parrhasius.*

Hesperia parrhasius, Fabr., Ent. Syst., iii., 1, p. 289 (1783).

Lycæna dipora, Moore, P.Z.S., 1865, p. 506, t. 32, fig. 8.

This is a tropical form of the wide-ranging *L. argiades*, Pall., which occurs in the North-west Himalaya under

the name of *dipora*, Moore. It seems rare in Sikkim at low elevations, but is very common in the Khasia hills in August and September at 4—6000 ft. on the grassy downs, and I have taken it also at Galle, in Ceylon.

A comparison of my Indian series, namely, ten pairs from the N.W. Himalaya, six pairs from Khasia, three from Ceylon, and one from Java, with six pairs from Japan, two from Shanghai, and twelve from Germany, leads me to doubt whether *parrhasius* and *argiades* can be distinguished with certainty. The summer brood in the Himalayas and Khasias are certainly darker below, and have a broader dark border to the wings above than *argiades*. The red patch on the anal angle of hind wing below is also better marked; but the spring brood in the N.W. Himalaya differ from the summer one as the German spring form (*polysperchon*) does from *argiades*, and I see no alternative between placing them all under one species, or separating several local races which do not, as far as my material serves me, seem to be constant.

257. *Jamides bochus.*

Papilio bochus, Cram., Pap. Ex., iv., t. 391, C, D (1782).

Common at low elevations in Sikkim, and also found in great numbers on sunny days in June on the top of Sinchul and other wooded ridges up to 8 or 9000 ft., where it probably ascends from below, as the insect is a purely tropical one, and I doubt its breeding in these cold, damp, misty forests, though on some occasions it seemed to be quite at home there.

258. *Chilades laius.*

Papilio laius, Cram., Pap. Ex., iv., t. 319, D, E (1782).
Polyommatus varunana, Moore, P. Z. S., 1865, p. 772, t. 41, fig. 6.
Chilades varunana, Moore, Lep. Ceyl., p. 77, t. 35, fig. 3; Wood-Mason & de Nicé., J. A. S. B., 1886, p. 365.

Only occurs in the Terai. According to de Nicéville *C. laius* is almost certainly the cold and dry-weather form of *varunana*.

259. *Chilades ? pontis.* (Pl. VIII., fig. 5).

Chilades pontis, Elwes, P. Z. S., 1887, p. 446.

Of this curious little species I know four specimens only, cf which one is unnamed in Mr. Godman's collection, and the other three were taken by myself on the bridge over the Rangbi jhora, on the road from Darjeeling to Serail, at an elevation of 6000 ft., on May 27th, 1886. The locality was in the middle of a dense damp forest, and the insects settled on the wooden bridge which was carried away by the torrent during the heavy rain (twelve inches in eight hours) which occurred on the night of June 18th, and which caused much destruction to life and property at Mongpo.

The illustration, which faithfully represents the species, makes a detailed description unnecessary, but I may say that it is most nearly allied to a species discovered by Maries at Kiukiang, in Central China, and described by me in P. Z. S., 1887, p. 446. From this, however, it is easily distinguished by the narrower border to the wings, which have a green reflection and less rounded apex. The markings beneath are very similar but less regular, and there is an extra band on the hind wing not found in the Chinese insect.

260. *Lampides ælianus.*

Hesperia ælianus, Fabr., Ent. Syst., iii., p. 280 (1798).

Common up to 4000 ft. from March to December.

261. *Lampides elpis.*

Polyommatus elpis, God., Enc. Meth., ix., p. 654 (1823).

Common with the last at the same elevation and seasons.

262. *Catochrysops strabo.*

Hesperia strabo, Fabr., Ent. Syst., iii., p. 287 (1793).

Not so common as in the plains, but occurs up to 3000 ft. from April to November. I took it below Mongpo in June.

263. *Catochrysops cnejus.*

Hesperia cnejus, Fabr., Ent. Syst., Suppl., p. 430 (1798).

Found in the Terai and lower hills, but not commonly.

264. *Catochrysops pandava.*

Lycæna pandava, Horsf., Cat. Lep. E. I. C., p. 84 (1829).

? *Catochrysops bengalia*, de Nicé., J. A. S. B., 1884, p. 47.

Fairly common in the hills up to 3000 ft. from April to August. The latter broods, which, according to Moller, replace it from September to December, differ in the markings of the under side, and are called *bengalia* by him.

Pandava is common in Calcutta in April, May, and October, but the females seem rarer both there and in Sikkim. Mr. de Nicéville now regards *bengalia* as the winter form of *pandava.*

265. *Castalius decidia.*

Lycæna decidia, Hew., Ex. Butt., v., Lyc., t. i., fig. 4 (1876).

A rare species in Sikkim up to 5000 ft. from April to October. It agrees very well with specimens from the Nilgiri hills, whence the type of *decidia* came.

266. *Castalius interruptus.*

Castalius interruptus, Moore, P. Z. S., 1883, p. 523, t. 48, fig. 4; de Nicé., J. A. S. B., 1883, p. 74, t. 1, fig. 12, ♀.

This species seems of very rare occurrence in Sikkim, where it has once or twice been obtained by Möller's collectors. It occurs more commonly in the plains of Maldah, in Orissa, and was described from Bombay by Moore. Möller thinks that it is only a seasonal form of *C. decidia.*

267. *Castalius ananda.*

Castalius ananda, de Nicé., J. A. S. B., 1883, p. 75, t. 1, figs. 11, ♂, 11*a*, ♀.

This pretty species is not uncommon in the valleys of the Rungit and other streams at 1—3000 ft. from April to October.

268. *Castalius roxus.*

Polyommatus roxus, Godt., Enc. Meth., ix., p. 659 (1823).

Common up to 4 or 5000 ft. from April to October.

? *Castalius elna.*

Lycæna elna, Hew., Ex. Butt., v., Lyc., t. i., 8 (1876).

Mr. de Nicéville notes this as occurring in Sikkim, and I have three specimens which agree with what he calls *elna* from the Andamans, but do not see how to distinguish them from *C. roxus.*

269. *Castalia rosimon.*

Papilio rosimon, Fabr., Syst. Ent., p. 523 (1775).

An insect of the plains rather than the hills, but it occurs in the Terai, and occasionally up to 3000 ft. almost all through the year.

270. *Nacaduba ardates.*

Lycæna ardates, Moore, P. Z. S., 1874, p. 574 (t. 67, fig. 1 not recognisable).

A common species in wet sandy places in river-beds, where they fly round and round close to the ground in little swarms like flies, constantly settling on the sand, and easy to take in quantity. I found these flocks composed of males alone, and never took a female myself; they are rare in all the species of this genus.

271. *Nacaduba macropthalma.*

Lycæna macropthalma, Feld., Zool. Bot. Ges., xii., p. 483 (1862); Reise Nov., ii., p. 273, t. 34, fig. 35.

Fairly common at 1 to 3000 ft. from April to November.

272. *Nacaduba atrata.*

? *Lycæna atrata*, Horsf., Cat. Lep. E. I. C., p. 78 (1828), ♀.

L. Kurava, Moore, Cat. Lep. E. I. C., p. 22 (1857).

A rare species, which occurs in the low valleys with the last, from which it is distinguished by the additional markings on the inner part of the hind wing below, and by the lighter, more slaty-blue colour which resembles the tint of *N. dana*. I have seen no females from Sikkim, and am not certain whether it is the same as Horsfeld's species, as the single specimen which I have from Padang, in Sumatra, is not fresh enough for an accurate comparison. I took a male in the Khasias, however, which agrees with Sikkim specimens, and have a female from there which agrees with it. Two females in Moller's collection differ from the same sex of *N. macropthalma* in having a broader dark margin to the fore wing, the base of which is strongly overlaid with glossy blue. The hind wing is darker, and the marginal bands more prominent.

273. *Nacaduba bhutea.*

Nacaduba bhutea, de Nicé., J. A. S. B., 1883, p. 72, t. 1, fig. 13, ♂.

This species, though very close to *ardates*, may be distinguished without difficulty, if fresh specimens are compared. The best character is in the lower spots of the discal series on the fore wing below, which form a bar right across the wing in *ardates*, and in *bhutea* are less in number, and do not reach the hind margin. De Nicéville says truly that the band crossing the middle of the cell on the fore wing below does not extend below it in *bhutea*, and, though in *ardates* it usually does, yet I find some specimens in which this bar is variable in length.

Bhutea is not so common as *ardates*, and, like it, frequents wet sandy spots in the beds of rivers at 1—3000 ft. I took it below Mongpo in June, and Möller gets it from April to October.

274. *Nacaduba dana.*

Nacaduba dana, de Nicé., J. A. S. B., 1883, p. 73, t. i., fig. 15.

This species is easily distinguished when fresh by the violet shade of the upper side and absence of tails, though, as *ardates* is sometimes tailless, I do not see why, as de Nicéville suggests, this should remove it from the same genus. It occurs from the Terai up to 7000 ft., but is not common, from April to October. Doherty found it in Kumaon up to 5000 ft. The female of *dana* has recently been procured by Moller in late autumn.

275. *Nacaduba viola.*

Lampides viola, Moore, Ann. Nat. Hist., 1877, p. 340.
Nacaduba viola, Moore, Lep. Ceyl., p. 89, t. 38, figs. 1, 1 *a*, *b*; Wood-Mason & de Nicé., J. A. S. B., 1886, t. xvii., 12, ♂.

Rare at 2 to 3000 ft. from May to October.

276. *Lycænesthes bengalensis.*

Lycæna bengalensis, Moore, P. Z. S., 1865, p. 773, t. 41, fig. 9.

Not uncommon up to 2000 ft. from April to October.

277. *Lycænesthes lycambes*, Hew.

Lycænesthes lycambes, Hew., Ill. Lyc., p. 220, t. xc., f. 11, 12.

Rarer than the last at the same elevation and seasons.

278. *Lycænesthes? cymbia.*

Niphanda? cymbia, de Nicé., J. A. S. B., 1883, p. 76, t. ix., figs. 8, ♂, 8 *a*, ♀.
N. plinioides, Moore, P. Z. S., 1883, p. 524, t. 48, fig. 8.

A not uncommon species in the low valleys up to 2 or 3000 ft. from April to October. De Nicéville's name was published on March 6th, according to him; Moore's on April 1st; so the former has priority.

279. *Catapœcilma elegans.*

? *Hypochrysops elegans*, Druce, P. Z. S., 1873, p. 350, t. 32, f. 12.

Catapœcilma elegans, Dist., Rhop. Mal., p. 235, t. xxii., fig. 17.

The specimens I have from Sikkim, some of which were taken in March and others by me on May 29th, 1886, near Mongpo, at about 3000 ft.—do not perfectly agree with that figured by Druce, though the under side of this insect is extremely difficult to depict well; they are also considerably smaller than the one figured by Distant, but if not the same insect, it is very close to it. I have both sexes, and since writing I have seen the types in Godman's collection, which are both worn females from Sandakan Bay, N.E. Borneo; they are much smaller, and seem to differ in the markings below, but are not fresh enough for an accurate comparison.

280. *Catapœcilma delicatum.*

Catapœcilma delicatum, de Nicé., P. Z. S., 1887, p 455.

C. bubases, Hew. apud de Nicé., J. A. S. B., 1885, p. 118, t. 11, figs. 11, ♂, 1, ♀.

This species, which seems very rare in Sikkim, is well described and figured by de Nicéville, but as Distant has pointed out that it is not the same as that described by Hewitson, he has afterwards given it a new name. It was found by Moller's collectors in April and May at 2—3000 ft.

281. *Horaga onyx.*

Thecla onyx, Moore, Cat. Lep. E.I.C., p. 30, ♂ (1857); P. Z. S., 1882, p. 247; de Nicé., J. A. S. B., 1883, p. 96.

Myrina ciniata, Hew., Ill. Di. Lep., p. 35, t. xiv., figs. 30, 31 (1863).

Myrina syrinx, Feld., Hew. Ill. Di. Lep., Lyc., t. xiv., figs. 32, 33.

Not uncommon at 1 to 3000 ft. from May to October. I have two specimens from Dhurmsala (*Hocking*) which I cannot distinguish from *ciniata*.

282. *Horaga viola.*

Horaga viola, Moore, P.Z.S., 1882, p. 248; de Nicé., J.A.S.B., 1883, p. 96.

I have both sexes of this species, named by Moore, from Kangra, whence the types came, and a male from Shillong, which agrees. The male is a smaller, darker insect than *onyx*, but the female has, to my eye, no perceptible difference, and, though de Nicéville keeps it distinct from *onyx*, neither he or Moore give any distinguishing characters. It is rare in Sikkim.

283. *Horaga sikkima.*

Horaga sikkima, Moore, P. Z. S., 1883, p. 525.

This also seems to me barely distinguishable from *H. onyx*, from which it is said to differ in the lower basal and discal areas being of a darker blue tint, the discal white spot on fore wing intermediate in size. I have seen the type in Moore's collection, but am not able to say whether the supposed characters are constant.

Moller says this may be distinguished by the shorter band of the fore wing below, which does not reach the costa; and, if this character is constant, it would be sufficient, but my specimens are not numerous enough to judge.

284. *Aphneus himalayanus.*

Aphneus himalayanus. Moore, J. A. S. B., 1884, p. 11.

This, which seems to be the commonest form of the genus in Sikkim, is here distinguishable from the other forms mentioned below, but whether these distinctions can be found constant in other localities I am unable to say, and I entirely disbelieve in the existence of so many forms as are described. It is found up to 3 or 4000 ft. from April to November.

285. *Aphneus elima.*

Aphneus elima, Moore, Ann. Nat. Hist., 1877, p. 51.

A species which agrees with what I have from Kangra, so-named by Moore, and also found near Calcutta, is found not uncommonly in the low valleys. It may be distinguished from either of the others in Sikkim by the dull brownish ground colour of the under side.

286. *Aphneus syama.*

Amblypodia syama, Horsf., Cat. Lep. E. I. C., p. 107 (1829).
Spindasis syama, Dist., Rhop. Mal., p. 243, t. xxiii., figs. 8, 9.

Distinguished from *himalayensis* by the yellower ground colour of the under side. Varies considerably in Sikkim.

Note.—Since this was written I am informed by Mr. de Nicéville that he has described three new species of this genus from Sikkim, namely, *Spindasis rukma*, *S. rukmini*, and *S. sani*, which will appear in the 'Journal' of Asiatic Society of Bengal.

287. *Tajuria longinus.*

Hesperia longinus, Fabr., Ent. Syst., Suppl., p. 430 (1798).
Iolaus longinus, Hew., Ill. Lyc., p. 45, ♀ (1865).

Must be somewhat rare in Sikkim, as I have never seen specimens in any of the older collections; but Möller gets it occasionally from the lower valleys. I believe it is rather an insect of the plains than the hills.

288. *Tajuria diæus.*

Iolaus diæus, Hew., Ill. Di. Lep. Lyc., p. 45, t. xx., 27, 28, ♂; 26, ♀ (1865).

I have seen no specimen of this species, which was described from North India, and, from the plate, should not have been able to say that it was distinct from the next; but de Nicéville appears to have got male specimens from Sikkim, as he compares *T. albiplaga* with it.

289. *Tajuria albiplaga.*

Tajuria albiplaga, de Nicéville, P. Z. S., 1887, p. 459, t. xxxix., fig. 1, ♂; 2, ♀.

Described from a single pair in Möller's collection, De Nicéville considers it a very distinct species, though I should not have thought so, from the plate and description.

290. *Tajuria melastigma.*

Tajuria melastigma, de Niceville, P. Z. S., 1887, p. 460, t. xl., fig. 1, ♂.

Described from a single male specimen in Möller's collection. De Nicéville thinks it may be the male of *T. ister*, Hew. It occurs also in the Nilghiri hills.

291. *Tajuria istroidea.*

Tajuria istroidea, de Nicé., P. Z. S., 1887, p. 458, t. xl., fig. 3, ♀.*

Described from a single female in Möller's collection, and nearly allied to *Iolaus ister*, Hew.

292. *Bindahara phocides* ?.

? *Hesperia phocides*, Fabr., Ent. Syst., iii., p. 282 (1793), ♀; Don., Nat. Rep., ii., t. xliv., fig. 1.

Bindahara phocides, Moore, Lep. Ceylon, i., p. 112, t. xlii., fig. 3, ♂; 3*a*, ♀.

I have a single male specimen of an insect which agrees very fairly with what is figured under this name by Moore. The type, which is a female, I have seen, and, though said by Fabricius to have come from Africa, is so like the female of the Ceylon insect that I do not see how to separate it; but the species described by Horsfeld from Java as *Amblypodia sugriva*, which is considered identical with *phocides* by Moore, has, instead of a narrow blue band on the outer edge of the hind wing, a large blue patch; and I believe it to be a distinct species. The specimen, which is the only one I have seen from Sikkim, was collected by me in July, 1870, and given with the rest of my insects of that year to Mr. Godman, in whose collection I recently found it. De Nicéville says it is also found near Buxa, Bhotan.

293. *Iolaus illurgis.*

Iolaus illurgis, Hew., Ill. Lyc., Suppl., p. 10, t. iv., figs. 37, 38, ♂ (1869).

Cophanta illurgis, Moore, J. A. S. B., 1884, p. 20.

Of this rare species I have seen only the type-specimens, which were collected by Atkinson in Sikkim; and one female, which is in Mr. Godman's museum.

* The male will be soon described also by Mr. de Nicéville in the 'Journal' of the Asiatic Society of Bengal.

294. *Iolaus maculatus.*

Iolaus maculatus, Hew., Ill. Lyc., p. 47, t. xxi., figs. 29, 30 (1865).

Cophanta maculata, Moore, *l. c.*, p. 21.

This is also a rare species, of which I have a pair, taken near Mongpo in July, I believe, at an elevation of 5—6000 ft., but of this I cannot be sure. Moller's collectors take it rarely in May and June at a low elevation. It is a beautiful insect, very distinct in the markings of the under side, which is white, with round black spots. The female is much larger, and the upper side is whitish, with a tinge of blue at the base only.

295. *Iolaus cotys.*

Iolaus cotys, Hew., Ill. Di. Lep., p. 43, t. xix., figs. 19, 20 (1865).

I have a single male of this rare species, taken in the valley of the Rungit in August, 1886. It agrees with Hewitson's type specimen, which is a female, and with two from Lidderdale's collection in the British Museum. Of the nearly-allied *Dacalana Burmana*, Moore, I have a single female from Akyab, which is of a pale violet-blue, showing the white band of the lower surface through both wings.

296. *Sithon jangala.*

Amblypodia jangala, Horsf., Cat. E. I. C., p. 113 (1829); Moore, Cat. E. I. C., t. i. *a*, fig. 11 (1857).

Not uncommon up to about 3000 ft., from April to October. The female, which does not seem to have been described, is in Möller's collection, and resembles the male, except that there is no purple on the upper side of the hind wing.

297. *Sithon jalindra.*

? *Amblypodia jalindra*, Horsf., Cat. E. I. C., p. 109 (1829).

Myria jalindra, Hew., Ill. Lyc., Suppl., p. 24, t. iii. *a*, fig. 96, ♂; 97, 98, ♀.

A very rare species, which has only once or twice been taken by Möller in November. Described from Java and Sumatra. I have seen no Sikkim specimens, and do not know whether what Möller calls *jalindra* is the same as Horsfeld's species.

298. *Sithon mandarinus.*

Myrina mandarinus, Hew., Ill. Lyc., p. 28, t. xi., figs. 6, 7, ♀.

This fine species is found in the Khasia, and, according to Moller, occasionally occurs in the low valleys of Sikkim during and after the rains. Perhaps this is the same as *fabronia*, Hew., but I have no Sikkim specimens for comparison, and those from the Khasia hills in my own and the Hewitson collection are not sufficient for comparison.

299. *Camena ctesia.* (Pl. VIII., fig. 6, ♀).

Camena ctesia, Hew., Ill. Di. Lep., p. 48, t. xx., figs. 1, 2 (1865).

Not an uncommon insect up to 3 or 4000 ft., from April to October. The female, which I here figure, has not been, as far as I know, previously described, and was taken by me in August at Rikisum, 6000 ft. elevation, in British Bhotan. The species also occurs in the Jaintia hills.

300. *Cheritra freja.*

Hesperia freja, Fabr., Ent. Syst., iii., p. 203 (1793).
Myrina jaffra, Horsf., Cat. Lep. E. I. C., p. 118, t. ii., figs. 5, 5*a*, (1829).

Not at all so common an insect in Sikkim, as it seems to be further east, and found only at the foot of the hills.

301. *Cheritra* (*Ticherra*) *acte.*

Myrina acte, Moore, Cat. E. I. C., i., p. 47, ♀ (1877); Hew., Ill. Di. Lep. Lyc., p. 30, t. xii., figs. 8, 9, ♂, dry season form (1863).
Ticherra acte, de Nicé., P. Z. S., 1887, p. 457, t. xl., fig. 5, ♂, wet season form.

I was on the point of describing the form figured by de Nicéville, when I received the MSS. of his paper, in which he pointed out that the marked difference in the colour of the under side of the two forms was probably a seasonal variation, and my own specimens confirm this opinion. I have one taken by Mr. Gammie's collector on February 28th, which is at least a third smaller than

the remainder of my series, five pairs; and shows the extreme effect of the dry season in reducing the size and dulling the colour of the under side of this species. It is so different from those taken in July that no one would consider it as the same species, if it stood alone. It occurs at low elevations almost all the year, at least from January to November.

302. *Cheritrella truncipennis.*

Cheritrella truncipennis, de Nicé., P. Z. S., 1887, p. 456, t. xxxix., figs. 4, ♂, 3, ♀.

I have only seen this rare species in Möller's collection; it was taken by his native collectors at a low elevation in June.

303. *Myrina ? symira.*

Myrina symira, Hew., Ill. Lyc., Suppl., p. 26, t. iii*b*, figs. 107, 108 (1869).

This very curious little species is unknown to me, excepting by the unique type specimen which I have seen in the Hewitson collection, and which is said to have been collected by the late Mr. Atkinson at Darjeeling. It much resembles a small form of *acte,* with the same yellow under side, but has no white spots on the hind wing. Possibly it is an aberration of *acte.*

304. *Myrina ? Cyara.*

Myrina Cyara, Hew., *l. c.,* t. iii.*b,* figs. 109, 110 (1869).

This, which appears to be the female of a to me unknown species, is also unique in Hewitson's collection, and said to be from Darjeeling. The marking of the underside is quite unlike that of any other known to me.

305. *Myrina ? Melisa.*

Myrina Melisa, Hew., *l. c.,* t. iii., figs. 82, 83, ♀ (1869).

This species also is unknown to me, except in Hewitson's collection; the types were collected by the late Mr. Atkinson at Moulmein and Darjeeling.

306. *Myrina fabronia.*

Myrina fabronia, Hew., *l. c.*, p. 28, t. iii *a*, figs. 90, ♂; 89, 91, ♀ (1869.)

I have never seen any other specimens than the types in Hewitson's collection, for which no locality is given; but, according to Moore, the species occurs in Sikkim.

307. *Hypolycæna kina.*

Hypolycæna kina, Hew., Ill. Lyc., Suppl., p. 13, t. v., figs. 32, ♂; 33, 34, ♀ (1869).

Rare in the low valleys during the greater part of the year.

308. *Hypolycæna othona.*

Hypolycæna othona, Hew., Ill. Lyc., p. 50, t. xxii., figs. 17, 18 (1865).

Common in the low valleys from March to October. All these beautiful insects are found in similar situations, namely, banks by the sides of streams in deep hot gorges. They frequently settle on the wet sand or mud on the paths or by water, and keep their long and delicate caudal appendages out of the wet without apparent difficulty. The females of all of them, which are less active than the males, are therefore more seldom seen, and rarer in collections. The female of *othona* has lately been obtained by Möller. He describes it as follows:— "Larger than the male; fore wing fuscous, darker on outer margins, with a patch of bluish white almost reaching the inner margin; the upper third of hind wing fuscous, the rest bluish white; on this wing only there is a very fine anticiliary black line, bordered inwardly by an equally fine white line. Underside as in the male."

309. *Hypolycæna (? Sinthusa) virgo.* (Pl. VIII., fig. 7).

Hypolycæna virgo, Elwes, P. Z. S., 1887, p. 446.

A single female of this beautiful insect, which I have been unable to identify with any described species, was taken by myself on May 27th, 1886, by the side of the path close to the Rungbi bridge, which I have previously mentioned as such a good place for forest insects.

Möller's collectors have never found it, so I presume it is an inhabitant of the zone of forest from 6—8000 ft.

310. *Hypolycæna (Sinthusa) chandrana.*

Hypolycæna chandrana, Moore, P. Z. S., 1882, p. 249, t. xi., figs. 2, 2*a*, ♂.
Hypolycæna Grotei, Moore, P. Z. S., 1883, p. 527, t. xlix., fig. 5.

The type of *chandrana*, which I have examined in the British Museum, is said to come from Lahoul; but I think this locality must be a mistake, as the insect is a tropical one, and Lahoul is a cold elevated valley in the North-west Himalaya; but I have two specimens taken in the adjoining valley of Kulu, at 5000 ft., on August 13th, by Capt. Young. I cannot see any difference between it and what is named *Grotei* in the British Museum collection, which is said to come from N.E. Bengal (Grote). I have, however, taken specimens of both sexes myself both in Sikkim and the Khasia hills. In the former district it was found in dense tropical jungle, at 2500 ft., in June and July; but it is out from March to October, and occurs up to 5000 ft. In the Khasia I found it among bushes in the more open country, at about 4000 ft., in September. A perfectly-fresh female taken here differs somewhat from the similar sex in Sikkim, but only in minor and variable characters; and I see no way of separating the Kulu, Sikkim, and Khasia specimens. Nothing is said by Moore on the subject, the descriptions of both species being nearly the same.

311. *Hypolycæna (Sinthusa) nasaka.*

Thecla nasaka, Horsf., Cat. Lep. E. I. C., p. 91 (1829).

Rare in Sikkim, at 1—5000 ft., during the rainy season. Does not differ from a Kangra specimen in my collection.

312. *Hypolycæna erylus.*

Polyommatus erylus, Godt., Enc. Méth., ix., p. 633.
Hypolycæna erylus, Hew., Ill. Lyc., p. 49, t. xxi., figs. 1, ♂; 2, 4, ♀ (1866).

Common at low elevations from April to December.

313. *Hypolycæna* (*Cheritra*) *etolus.*

Papilio etolus, Fabr., Mant. Ins., ii., p. 66 (1787).
Hypolycæna etolus, Hew., Ill. Lyc., t. xxii., figs. 19, 20 (1865).

Common at same elevation and seasons as the last.

314. *Deudorix* (*Rapala*) *orseis.*

Deudorix orseis, Hew., Ill. Lyc., p. 23 (1863).
? *Deudorix grisea*, Moore, P. Z. S., 1879, p. 140.

Not uncommon at low elevations from April to November. No figure having been given of either of these species, I have examined the specimen of *orseis* in Hewitson's collection, and agree with de Nicéville in considering *D. grisea* probably the same, though the type of the latter comes from the N.W. Himalaya, and that of the former from Sumatra. I have this species also from the Khasia hills and Andaman islands.

315. *Deudorix* (*Rapala*) *schistacea.*

Deudorix schistacea, Moore, P. Z. S., 1879, p. 140.

I have never taken a specimen of this in Sikkim, but de Nicéville and Moller have both procured it with the last. I have it also from Malabar, Burmah, Bhutan, Cachar, and the Philippine islands.

316. *Deudorix* (*Rapala*) *distorta.*

Rapala distorta, de Nicé., P. Z. S., 1887, p. 461, t. xl., fig. 6, ♀.

Two female specimens of this species were taken by Möller on March 22nd, at 1500 ft.; another female in August. The male as yet is unknown.

317. *Deudorix* (*Bidaspa*) *jarbas.*

Papilio jarbas, Fabr., Mant. Ins., ii., p. 68 (1787).
Thecla sorya, Koll., Hugel's Kash., p. 414, t. v., figs. 1, 2 (1848).

Common at low elevations from June to December.

318. *Deudorix (Bidaspa) nissa.*

Thecla nissa, Koll., Hugel's Kash., p. 412, t. iv., figs. 3, 4 (1848).
Deudorix nissa, Hew., Ill. Lyc., t. x., figs. 42, 43 (1863).

Not rare up to about 3000 ft. from February to October. There are two very distinct-looking forms of this species, but a large series from the N.W. Himalaya, Sikkim, and Khasia, leave me no doubt that they cannot be separated. In the Khasias it is one of the commonest species.

319. *Deudorix epijarbas.*

Dipsas epijarbas, Moore, Cat. E. I. C., i., p. 32 (1857).
Deudorix epijarbas, Hew., Ill. Lyc., t. vii., figs. 16—18 (1863).

Common up to 3 or 4000 ft. from April to December.

320. *Deudorix (Vadebra) petosiris.*

Deudorix petosiris, Hew., Ill. Lyc., p. 22, t. ix., figs. 30, 31 (1863).

Common in Sikkim at low elevations.

321. *Deudorix amyntor.*

Papilio amyntor, Herbst., Nat. Schmett., t. 300, figs. 5, 6, ♀ (1804).
Deudorix amyntor, Hew., Ill. Lyc., p. 17, t. viii., figs. 19, 20, ♂ (1863).

A very rare species in Sikkim. Möller had only procured two specimens until 1887, but this year has had several from his native collectors.

322. *Deudorix (Virachola) perse.*

Deudorix perse, Hew., Ill. Lyc., p. 18, t. viii., figs. 24, 25, ♂; 26, ♀ (1863).

Möller says that this species occurs up to 9000 ft., but I think it must be but a straggler at this elevation; and it is not common in Sikkim, though found almost all through the season.

323. *Deudorix (Iraota) timoleon.*

Papilio timoleon, Stoll, Suppl. Cram., t. xxxii., figs. 4, 4*d*.

? *Amblypodia rochana*, Horsf. & Moore, Cat. E. I. C., t. i. *a*, fig. 10.

Rare in Sikkim at low elevations from May to October.

324. *Deudorix (Iraota) mæcenas.*

Hesperia mæcenas, Fabr., Ent. Syst., iii., p. 271; Don, Ins. China, t. xli., fig. 2.

Thecla nila, Koll., Hugel's Kash., p. 413, t. iv., figs. 5, 6.

Also rare at same elevation and seasons as the last.

325. *Pratapa Bhotea.*

Pratapa bhotea, Moore, J. A. S. B., 1884, p. 22.

An insect described under this name from Sikkim is in the Calcutta Museum, and also in Möller's collection, but seems very rare. Möller includes *P. deva* in his list, but I have no specimen to identify, and suspect it is the above species.

326. *Ilerda epicles.*

Ilerda epicles, Godt., Enc. Meth., p. 646 (1823).

This is a very common species up to about 4000 ft. from April to December. Both sexes vary considerably, the males in the size of the red lunules on the hind wing, which are sometimes quite absent on the upper side; and in the colour of the fore wing, which in one form is deep purple, with a broad black border, whilst in others it is of a much duller purple, with a red blotch more or less distinct on the disc. The females also vary in the size of the red patch on the fore wing, and in the extent of the red band on the hind wing.

327. *Ilerda androcles.*

Ilerda androcles, Doubl. Hew., Gen. Di. Lep., t. lxxv., fig. 2 (1852).

Ilerda Hewitsoni, Moore.

A very abundant species in the forest at 6—9000 ft. during the rainy months, where it collects in groups on

sunny spots on the road, settling with open wings and flying very rapidly round and round. I have taken it as early as May 27th, and as late as December, but July and August are the height of the season. I have specimens of the female, marked *Hewitsoni*, Moore, from Hocking's collection, though neither *androcles* nor *Hewitsoni* are included in the list of this collection published by him, and I have it also from Kulu and Pangi, taken at 4000 ft. in March. I took this species among bushes on the edge of the forest in one or two places on the Khasia hills, at 5—6000 ft., in September. The females are very difficult to distinguish from those of *tamu* and *Moorei*, but I never found two species flying in the same localities in Sikkim.

328. *Ilerda brahma.*

Ilerda brahma, Moore, Cat. Lep. E. I. C., i., t. i. *a*, fig. 4, ♂.

This lovely insect is common at about 3—6000 ft. from June to December, but most abundant in July and August. I found it on forest-paths in sunny places, and it has the same habits as *I. androcles*.

329. *Ilerda Moorei.*

Ilerda Moorei, Hew., Ill. Di. Lep., p. 58, No. 5 (1865).

Ilerda saphir, Elwes, P. Z. S., 1882, p. 403, t. xxv., figs. 9, ♂, 10, ♀ (nec Blanch.).

Though the impossibility of depicting the metallic shade of colour in these nearly-allied species makes the figure of this species referred to very like what I take to be *tamu* of Kollar. = *coruscans*, Moore, yet in the shade of its blue, which is purplish rather than greenish, it is very distinct. Since I first received it in 1881 from native collectors, I have had other specimens from the interior to the eastward, but never from British Sikkim. I have received a specimen of *I. saphir* from Paris, taken at Moupin, in East Tibet, which shows that I was wrong in my identification, as *saphir* seems to be much nearer to, if not identical with, *Oda*, Hew., from the N.W. Himalaya.

330. *Thecla duma.*

Dipsas duma, Hew., Ill. Di. Lep., Suppl., p. 15 (1869).

This species is common on Sinchul at 7—8000 ft., and I have also taken it on the Gumpahar road. It flies during the height of the rainy season in June, July, and August, and settles on the road or on ordure in open places. The female, which I have only once seen alive, is much rarer, and a very different insect in appearance, being uniform dark brown, with a large patch of reddish yellow on the disc of the fore wing, resembling the female of *T. icana*, though larger.

331. *Thecla syla.*

Thecla syla, Koll., Hugel's Kash., p. 414, t. iv., figs. 7, 8 (1848).

Dipsas syla, Hew., Ill. Di. Lep., t. xxvi., fig. 3 (1865).

This species is much rarer than in the N. W. Himalaya, and I have seen no specimen of it myself in Sikkim; but Möller notes it as found from 8—10,000 ft. in July and August.

332. *Amblypodia camdeo.*

Amblypodia camdeo, Moore, Cat. Lep. E. I. C., p. 41, t. i. *a*, fig. 6 (1857).

This species, which is not uncommon in the Khasia hills and Assam, is of doubtful occurrence in Sikkim, though Möller has taken it in the Terai.

333. *Amblypodia amantes.*

Amblypodia amantes, Hew., Cat. Lyc. B. M., p. 4, t. ii., figs. 1, 3 (1862).

Also confined to the Terai.

334. *Amblypodia eumolphus.*

Papilio eumolphus, Cram., Pap. Ex., iv., t. 229, *g*, *h* (1782).

Amblypodia eumolphus, Hew., Cat. Lyc. B. M., t. viii., figs. 8, 9 (1862).

This beautiful species, the male of which is of a brilliant green, like *Thecla duma*, whilst the female is of

the usual blue-black colour of the genus, is not uncommon at low elevations from March to December.

335. *Amblypodia centaurus.*

Papilio centaurus, Fabr., Syst. Ent., p. 520 (1775).
Amblypodia centaurus, Hew., Cat. Lyc. B. M., t. ii., figs. 10—13 (1862).

Common at low elevations from April to December.

336. *Amblypodia anita.*

Amblypodia anita, Hew., Cat. Lyc. B. M., p. 14, t. 8, figs. 90, 91 (1862).

Of this very distinct-looking species I have a single specimen only, which I brought from Sikkim in 1871, and gave with the rest of my first collection to Mr. Godman. I have compared it, and find that it agrees with the type of *anita*, Hew., which is from Siam, whilst other specimens in the Hewitson collection placed under this name differ considerably.

337. *Nilasera? asoka.*

Nilasera? asoka, de Nicé., J. A. S. B., 1883, p. 78, t. ix., figs. 6, ♂; 6*a*, ♀.

Not uncommon at from 1 to 3000 ft. from June to October.

338. *Nilasera? adriana.*

Nilasera? adriana, de Nicé., *l. c.*, p. 79, t. ix.. figs. 5, ♂; 5*a*, ♀.

One of the commonest of the Amblypodias in the low valleys, with the last. It is very like the last on the upper side, but the male has a broader black border, and the absence of the green anal spots on the hind wings beneath is a good and constant difference.

Satadra luzula.

Satadra luzula, Moore, J. A. S. B., 1884, p. 25.

I am unable, from the description of the species, to tell whether it is distinct or not, as it is only compared

with a newly-described and doubtful species, *S. chola*, and no figure of either is given.

339. *Amblypodia areste.*

Amblypodia areste, Hew., Cat. Lyc. B. M., p. 10, t. v., figs. 43, 44 (1862).
? *Satadra chola*, Moore, J. A. S. B., 1884, p. 24.

This beautiful species occurs, but not commonly, at 3—4000 ft. from July to October, and I have a single specimen taken below Mongpo at about 2000 ft. on February 2nd by Mr. Gammie's collector. I cannot, by the description, distinguish *S. chola*. When Mr. Moore says, "closely allied," and gives no figure, there is a very strong probability of identity in my opinion; de Nicéville, however, thinks it may be the same as *asoka*.

340. *Nilasera? Molleri.*

Nilasera? Moelleri, De Nicé., J. A. S. B., 1883, p. 80, t. ix., figs. 4, ♂; 4 *a*, ♀.

Nearest to, but quite distinct from, the last; it is found at 2—3000 ft., but not commonly, during the rains from June to October. I also have a specimen from the Jaintea hills.

341. *Nilasera? fulgida.*

Amblypodia fulgida, Hew., Ill. Lyc., p. 11, t. v., fig. 31, ♀ (1863).
Nilasera? fulgida, de Nicé., J. A. S. B., 1883, p. 80, t. ix., figs. 3, ♂; 3 *a*, ♀.

Not uncommon at 1—4000 ft. I have only taken it below Mongpo on May 29th, but its season is from the beginning to the end of the rains.

342. *Nilasera? bazalus.*

? *Amblypodia bazalus*, Hew., Cat. Lyc. B. M., t. iv., figs. 37, 38 (1862).

A rare species, which has only been taken in Sikkim by Mr. de Nicéville, and by Moller's men at 2—3000 ft. during and after the rains. Möller now thinks that what is recorded by de Nicéville as *bazalus* is the female of *eumolphus*.

343. *Nilasera? abseus.*

Amblypodia abseus, Hew., *l. c.*, t. v., figs. 51, 52.

Though I have never taken it myself, this species is, according to Möller, common up to 8 or 9000 ft., and occurs from June to November.

344. *Satadra? ænea.*

Amblypodia ænea, Hew., Ill. Lyc., p. 14 *e*, t. iii. *c*, fig. 55 (1869).

Not a common species, but it is found at low elevations in the cold weather as well as in the rains, as I have three specimens taken by Mr. Gammie's collector at 1500 ft. in December and February.

Satadra bupola.

Amblypodia bupola, Hew., Ill. Lyc., Suppl., p. 21, t. vii., figs. 64, 65.

A rare species, which occurs at low elevations. A female specimen in my collection does not show the gold-green on the three caudal spots mentioned in Hewitson's description, but very slightly shown in his figure, and agrees with some of the specimens in his collection.

345. *Satadra singla.*

Satadra singla, de Nicé., J. A. S. B., 1885, p. 119, t. xi., figs. 8, ♂; 7, ♀.

This species has only been recently discriminated by de Nicéville, who distinguishes it from *bupola* by the narrower and longer fore wing, the darker shade of purple on the upper side, and the violet-whitish powdering of the hind wing below. It is found rarely at the same elevation and seasons as most of these nearly-allied species, which seem, however, to keep quite distinct from each other.

346. *Satadra teesta.*

Satadra teesta, de Nicé., J. A. S. B., 1886, p. 253, t. xi., fig. 3, ♂.

A rare species, which is taken by Möller's collectors in the Teesta Valley. It is very near the last, and I

do not yet know how the females can be distinguished; but de Nicéville separates it on account of the fore wing being shorter and truncated instead of produced at the apex, the marginal black border only a quarter as wide, and the colour of both wings above of a deeper shade of purple than in any other species of the group known to him.

347. *Satadra atrax.*

Amblypodia atrax, Hew., Cat. Lyc. B. M., p. 13, t. vii., figs. 80, 82 (1862).

A rare species, occurring up to 3000 ft. from April to October.

348. *Amblypodia* (*Surendra*) *Quercetorum.*

Amblypodia quercetorum, Moore, Cat. Lep. E. I. C., p. 42, t. 1 *a*, fig. 7 (1857).

A common species up to about 4000 ft. almost all through the year.

349. *Amblypodia* (*Panchala*) *rama.*

Thecla rama, Koll., Hugel's Reise, p. 412, t. iv., figs. 1, 2 (1844).

This species seems much rarer in Sikkim than in the North-west, where it occurs from 1 to 8000 ft., and, though it belongs to a tropical group, it was found flying over ground at 7500 ft., powdered with snow in December, by Mr. Doherty. In Sikkim its range is only up to about 3000 ft., according to Möller, and its season from April to October.

350. *Amblypodia* (*Panchala*) *perimuta.*

Amblypodia perimuta, Moore, Cat. E. I. C., p. 42; Hew., Ill. Lyc., Suppl., t. vii., fig. 61.

Rare up to about 3000 ft. from June to October.

351. *Amblypodia* (*Panchala*) *paramuta.*

Panchala? paramuta, de Nicé., J. A. S. B., 1883, p. 81, t. ix., figs. 7, ♂, 7 *a*, ♀.

Rare up to 3000 ft. from April to October.

352. *Amblypodia (Acesina) paraganeesa.*

Amblypodia paraganeesa, de Nicé., J. A. S. B., 1882, p. 63.

A. ganeesa, Hew., Cat. Lyc. B. M., t. vii., fig. 72 (nec Moore).

Not so rare as the last, at the same elevation and season. It is very distinct from *ganeesa*, and occurs also in the Khasia hills.

PAPILIONIDÆ.

PIERINÆ.

353. *Pontia xiphia.*

Papilio xiphia, Fabr., Sp. Ins., ii., p. 43 (1781).

P. nina, Fabr., Ent. Syst., iii., 1, p. 194 (1793).

Not common in Sikkim, but I have taken it below Mongpo in June, and it occurs up to 4 or 5000 ft. from April to October.

354. *Delias pasithoe.*

Papilio pasithoe, Linn., Syst. Nat., ii., p. 755 (1767).

Not uncommon up to about 3000 ft. from April to December.

355. *Delias pyramus.*

Thyca pyramus, Wall., Trans. Ent. Soc. Lond., 1867, p. 347.

Pieris thisbe, Gray, Lep. Nepal, p. 8, t. vii., f. 1, ♂; *P. thisbe*, ♂, Boisd., Sp. Gen., p. 449, ♀.

Wallace separates the Indian form from the Chinese species (*thysbe*, Cram.), but I have been unable to make a comparison on account of the rarity of Chinese insects, which seem to come to Europe much less frequently than they did formerly. It is an extraordinary thing that, as far as I know, no modern entomologist has seriously collected the insects of South China, which would have the greatest scientific value, as the types described by old authors are now often difficult to identify.

356. *Delias eucharis.*

Papilio eucharis, Drury, Ins., ii., t. x., f. 5, 6; Cram., 201, B, C, 202, C (nec Fab.).

Occurs at low elevations from April to October, but an insect of the plains rather than the hills.

357. *Delias descombesi.*

Pieris Descombesi, Boisd., Sp. Gen., p. 465 (1836).

Common at low elevations, and up to 3000 ft., from March to December. I found it with *P. hippoides* and other *Pieridæ* fond of settling on the sweet-scented flowers of *Cinchona Ledgeriana* in the lower plantations at Mongpo. I have a very curious hermaphrodite of this species, in which the right-hand wings are those of a female and the left-hand ones those of a male; the corresponding sides of the extremity of the abdomen also appear to be those of the two sexes, but in their dried and somewhat shrivelled condition I cannot see whether the male clasper on the left side is perfect.

358. *Delias hierte*, var. *indica.*

Thyca hierte, var. *indica*, Wall., Trans. Ent. Soc. Lond., 1867, p. 351.

Not uncommon at the same elevation and seasons as the last.

359. *Delias agostina.*

Pieris agostina, Hew., Ex. Butt., vol. i., *Pieris*, i., figs. 1, 2, ♂; Wall., *l. c.*, p. 353, ♀.

Not uncommon in the lower valleys from March to December.

359. *Delias belladonna.*

Pieris belladonna, Fabr., Ent. Syst., iii., p. 180 (1793); Don., Nat. Rep., i., t. xxxv. (1823).

P. Horsfeldii, Gray, Zool. Misc., i., p. 32; Ins. Nep., t. viii., fig. 2.

Delias ithiela, Butl., Ann. Nat. Hist., 1869, iv., p 242.

D. Hearseyi et *D. Boyleæ*, Butl., *l. c.*, 1885, xv., p. 58.

D. berinda, Moore, P. Z. S., 1872, p. 566, ♀.

D. belladonna, Elwes, Ann. Nat. Hist., 1886, p. 157, *et seq.*

Having recently written on this species, I was careful to take especial notice of its habits during my last visit to India, and, though I am not able to change my opinion that there is only one species under the several names which have been given to it, yet I am able to add something to our previous knowledge. I found the dark form *ithiela* most common in Sikkim from May to

August at low elevations, 2—4000 ft., where it frequents the banks of streams in hot, thoroughly tropical valleys, and flies slowly about the water-side, resting sometimes on mud and pebbles almost in the water. Some specimens of the variety with yellow on the abdominal margin occur here with the pure black one, and some have white or only a yellow tinge in the same part of the hind wing. But neither Moller or I have ever taken females with the males in these places, and all the five females I possess of this form were procured from native collectors, and vary in the same particulars as the males. I never saw a typical *Horsfeldii* at these low elevations, but found it in the dense forest on Sinchul at 6 to 8000 ft., where it settles on paths and in damp places on the ground, and flies slowly in the same manner as *ithiela*. The only female of this form which I got was taken by my native assistant at an elevation of nearly 11,000 ft. on the road between Tonglo and Sundukpho, where it had probably been driven up by the wind, and both this and another similar female given me by Möller are intermediate between the *ithiela* females and those of the typical *Horsfeldii* from the North-west Himalayas. In the Khasia hills I was fortunate enough to find *Belladonna* in its breeding-places, which are the small patches of natural forest left on the higher parts of the hills at from 4000 to 6400 ft. elevation. Here it is in some places abundant, and I found the females almost as plentiful as the males. In the wood which crowns the summit of the Shillong peak I had several opportunities of observing the habits of the insect, which are quite different from what I saw in Sikkim. They fly on sunny days about the tops of the trees, and make little excursions into the open country round, always returning to the shelter of the wood, and frequently descending to settle on the flowers of a species of *Euonymus*, and of a large species of *Scabiosa* which grew on its outskirts. The flight is slow, graceful, and soaring, and the butterflies are not at all shy. Here I found hardly any variation in the insects, all being true *ithiela*, excepting two specimens, which were slightly tinted with yellow on the abdominal margin. I figure a female of the Khasia form, which has also been named *berinda* by Moore, and a female of the *Horsfeldii* type from Sikkim,

which closely resembles the North-western *Horsfeldii* from the Mandra plateau, in Kulu, taken at 8500 ft. by Capt. Graham Young. These are selected from 35 males and 18 females in my collection.

The facts as to the geographical distribution of this species which we know are as follows:—In E. Tibet, and probably S. China, the typical *Belladonna* of Fabricius is the dominant form.* In Sikkim, at 6—10,000 ft., the same form, somewhat darker. In Nepal and the North-western Himalayas *Horsfeldii* of Gray is found. In the Khasias, and at low elevations in Sikkim, we have the dark variety *ithiela* varying in the colour of the abdominal margin, which is sometimes yellowish and sometimes white.

In the North-western Himalayas, Simla, Kulu, and elsewhere, we have *sanaca*, Moore, a much paler form, which may be distinct, but I do not know enough of it to speak certainly on this point. Capt. Lang says of it, P. Z. S., 1865, p. 491:—"Very rare; obtained only in one richly-wooded glen far in the interior. Its flight was very strong and fast."

360. *Prioneris thestylis.*

Pieris thestylis, Doubl. Gray, Zool. Misc., p. 76 (1842); Doubl. Hew., Gen., t. vi., fig. 2 (1847).

? *Prioneris seta*, Moore, P. Z. S., 1857, p. 102, t. 44, fig. 3, ♀.

P. seta, Wall., Trans. Ent. Soc. Lond., 1867, p. 384.

P. watsoni, Hew., *l. c.*, 1868, p. 100.

This is, as Mr. Wallace remarks, a very puzzling species, which, if I had only seen the two extreme forms, I should not hesitate to separate; but, as he remarks, there are a series of variations by which *watsoni* or *seta* is brought nearer and nearer to *thestylis*.

From Sikkim I have six males and five females, of which four males are *thestylis*, and two approach *watsoni*. From Buxa, in Bhotan, I have a male which is typical *thestylis*. From the Khasias I have a female which is so large and dark, showing only a trace of yellow at the

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* In a collection just received by Mr. Leech from near Ichang, on the middle course of the Yang-tse-kiang river, are many specimens of *Belladonna* which, though unset when I saw them, seem identical with those from E. Tibet.

anal angle, so that it might well be supposed to belong to a different species from the Sikkim one. This specimen mimics *Delias belladonna* var. *ithela* so well that until it was set I did not recognise it as *thestylis*. From Burmah and Tenasserim I have fifteen males, of which some are like the Sikkim *watsoni* and some the extreme form of it. Moller is of opinion that they cannot be separated in Sikkim, and I agree with him; but I could not at present decide as to the Tenasserim insect. My Sikkim females show much variation in the amount of yellow on the upper side, and I have seen no specimen like that described by Wallace.

The males are not uncommon in Sikkim up to 4000 or 5000 ft. throughout the season; the females rarer.

361. *Prioneris clemanthe.*

Pieris clemanthe, Doubl., Ann. Nat. Hist., xvii., p. 23 (1846).

Occurs, but not commonly, in the lower valleys from April to October; the female, however, seems quite rare.

362. *Catopsilia pyranthe.*

Papilio pyranthe, Linn., Mus. Ulr., p. 245 (1764).
Callidryas pyranthe, Boisd., Sp. Gen., i., p. 611 (1836).

Common up to 3000 ft. from March to December.

363. *Catopsilia gnoma.*

Papilio gnoma, Fab., Syst. Ent., App., p. 828, ♂ (1775).
P. philippina, Cram., Pap. Ex., iv., t. 361, C, D (1782).

Not uncommon up to 3000 ft. from March to December.

364. *Catopsilia catilla.*

Papilio catilla, Cram., Pap. Ex., iii,, t. 229 D, E (1782).

Not uncommon up to 5000 ft. from March to December.

365. *Catopsilia crocale.*

Papilio crocale, Cram., Pap. Ex., i., t. 55 C, D (1779).

I have no specimens from Sikkim, but I have it from Nepal and Bhotan, so that I have no doubt it occurs occasionally, if not regularly.

366. *Terias hecabe.*

Papilio hecabe, Linn., Syst. Nat., i., 11, p. 763 (1767).

I shall not attempt to give the synonymy of this species here, because the number of names which has been applied to the various forms of this insect by Messrs. Butler and Moore is so great that it would cover half the page, and moreover, I should be unable to say, without having seen the so-called types of these species, that they were certainly identical with *hecabe*, though some of mine have been otherwise named by Swinhoe and Moore; but, after examining carefully about 200 specimens from all parts of India in my collection, of which 40 are from Sikkim, I do not see my way to define more than one species. It is as common here as elsewhere, and extends from the Terai to at least 10,000 ft. elevation.

The most marked varieties are as follows: a large lemon-yellow insect, which Swinhoe and Moore call *hecabeoides*, having a broad border extending round the posterior angle of the fore wings and half-way down the costa, with a border of about a line wide on the hind wings, and no brown patch at the apex of the fore wing beneath. The females are paler, more or less flecked with dark scales on both wings above, and have a broader, less-defined border on the hind wings. This form occurs during the rains in the lowest and hottest valleys, and agrees perfectly with what I took at Teria Ghat, in the Khasias. At Mongpo, 3—4000 ft., the prevalent form is smaller and rather brighter yellow above, but otherwise similar; and a very dwarf form, not more than two-thirds the size of the common one, occurs in both sexes in June, and probably at other seasons. At higher elevations, and up to the top of Tonglo, the same form, but usually smaller, occurs during June, July, and August.

In the spring months, at low elevations, the band of the fore wings in the male is reduced to a narrow edging of black on the posterior half, and does not extend round the angle, but this is not constant. In the hind wing the border is reduced to a very narrow line, sometimes only showing in the form of specks at the ends of the veins.

The under side has a conspicuous brown patch at the apex of the fore wing, and the brown markings are more distinct than during the rainy season, sometimes showing through on the upper side. The female of this form, however, has the black borders of both wings fully as broad as in the later broods, and though I am not in a position to say that this extremely broad-bordered female belongs to the almost borderless male, yet I have no other specimens which agree so well with them on the under side.

In some of these large females, which are like nothing I have from other places, the patch on the disk of the fore wing below shows plainly on the upper side as a short blackish bar at the end of the cell.

All these facts go to prove that climate, season, and temperature are influences which can modify to a great extent the size, colour, and markings of *Terias hecabe*; and, until the advocates of the subdivision of species have shown facts tending in the opposite direction, I shall refuse to recognise the validity of their undefined, and, as I maintain, undefinable species.

367. *Terias rubella.*

Terias rubella, Wall., Trans. Ent. Soc. Lond., 1867, p. 323.

? *T. drona*, Horsf., Cat. E. I. C., p. 137, t. 66., f. 13 (1829).

This, though one of the commonest *Terias* in the North-west Himalaya, the Khasias, and Western India, is very rare in Sikkim. I have but one or two specimens of it, and, according to Möller, it is only found at the foot of the hills. If the Himalayan insect is really distinct from the Malayan, as Wallace says it is, it must bear the name of *rubella*, which Wallace described from China, Calcutta, and Darjeeling. I have not the same material from the Malay Islands which Wallace had for comparison, but I cannot allow that two species of this form exist in the Himalayas, as Moore says.

368. *Terias læta.*

Terias læta, Boisd., Sp. Gen. Lep., i., p. 674 (1836).
T. santana, Feld., Reise Nov., ii., p. 211 (1865).

This species occurs, but not abundantly, in Sikkim at 7 to 9600 ft. elevation in July, August, and September, but I have never taken it myself.

369. *Terias venata.*

Terias venata, Moore, Cat. E. I. C., p. 65, t. 2 *a*, fig. 2 (1857).

Found at 6—9000 ft., but locally, and not so common as in the Khasias or N.W. Himalayas. There is some question as to whether the species is really distinct, but a large series of it is easily distinguished from *drona* and *læta* by the shape of the border of the fore wing.

370. *Terias harina.*

Terias harina, Horsf., Cat. E. I. C., p. 137 (1829).

Rare at low elevations up to about 3000 ft. from April to December.

371. *Colias Feildi.*

Colias Feildi, Men., Cat. Mus. Petr., p. 79, t. i., fig. 5.
C. Feildii, Elwes, Trans. Ent. Soc. Lond., 1884, p. 7.
? *C. Edusa*, Gray, Lep. Nepal, t. 5, fig. 2.
C. Edusa var. *myrmidone*, Moore, P. Z. S., 1865, p. 292.
C. myrmidone, Koll., Hugel's Kash., p. 411; Elwes (nec Esp.), P. Z. S., 1882, p. 401.

Very abundant in the interior at high elevations in the rains, and found more rarely near Darjeeling during the whole year, according to Moller. I have only seen it myself in July at a small clearing called Lepcha-jaga, on Goompahar, about 7000 ft., and on the open parts of the Singalelah range from 10 to 12,000 ft.; but I also found it not common in the Khasias at 5—6000 ft. in September.

372. *Dercas verhuelli.*

Colias verhuellii, Hoev., Tjid. Nat. Gesch., v., t. viii., figs. 3, 4 (1838).
Gonepteryx verhuellii. Doubl. Hew., Gen. Di. Lep., t. viii., fig. 3 (1847).

Not uncommon in certain places up to 4000 ft. from May to October.

373. *Dercas Wallichii.*

Gonepteryx Wallichii, Doubl., Proc. Ent. Soc. Lond., v., p. 47 (1849).
? *Dercas Wallichii*, Elwes, P. Z. S., 1882, p. 402.
? *Gonepteryx urania*, Butl., P. Z. S., 1865, p. 458, t. xxvi., fig. 5, ♀.

The single specimen which I mentioned before as having been brought from the interior by native collectors is the only one I have ever seen or heard of from Sikkim. On comparing it again with Butler's plate, I think that his species is probably the female, as the differences shown in it are much the same as those which are found in the two sexes of *D. verhuelli*, but the abdomen being wanting in the type of *urania*, it is not possible to say this with certainty.

374. *Pieris (Aporia) agathon.*

Pieris agathon, Gray, Zool. Misc., p. 33 (1831); Lep. Nep., t. 8, fig. 1 (1846).

A single specimen of this species was brought by my native collectors from the interior towards Bhutan in 1883, but it has not been obtained certainly in Sikkim.

375. *Pieris Dubernardi.*

Pieris Dubernardi, Ober., Et. Ent., ix., p. 13, t. i., fig. 6.

This species is only known to me from some eight or nine specimens, which were brought by a native employed by the late Capt. Harman, R.E., in surveying the Tibetan frontier, and may not occur on this side of the passes. It agrees very well with Oberthur's figure and description, taken from two specimens obtained at Tsekou, in Eastern Tibet, which, like my own, were all males.

376. *Pieris canidia.*

Pieris canidia, Sparrm., Amæn. Acad., vii., p. 504, note (1768).
P. gliciria, Cram., Pap. Ex., ii., t. 171, E, F (1779).

Common in Sikkim at 4 to 12,000 ft. during the rainy season, and found, according to Moller, as low as

3000 ft. from March to December. The form found in Sikkim is variable in size, the smallest I have being taken at Mongpo, 4000 ft., in June, and the largest in December, but none of them are so heavily marked on the hind wings as those I have from the Khasias and Nilgiri hills, and none of them are so small and lightly marked as the spring brood found in the North-west Himalaya, some of which come very close to the var. *palæarctica*, Stgr., from Namagan, in Turkestan. I have a single, very heavily-marked female from Ladak, with an additional spot below the cell on the hind wing, and no yellow at the base of the hind wing beneath, which I considered as a variety of *canidia*, but I now think it is more probably the undescribed female of *P. deota*, de Nicéville, as *canidia* has not to my knowledge been taken in the dry climate of Ladak.

377. *Pieris brassicæ.*

Pieris brassicæ, Linn., Syst. Nat., x., 467.
P. brassicæ var. *nipalensis*, Doubl., Lep. B. M., ii., p. 32; Gray, Lep. Nepal, p. 9, t. vi., figs. 1, 3.
P. nepalensis, Moore, P. Z. S., 1865, p. 49.

I cannot separate this from *brassicæ*, as I have before remarked. It is commoner in the interior than at Darjeeling, but occurs there from March to December, and as low as 3000 ft.

378. *Pieris melete.*

Pieris melete, Men., Cat. Mus. Petr., i., p. 113, t. x., 1, 2 (1855).
P. ajaka, Moore, P. Z. S., 1865, p. 490, t. xxxi., fig. 16; Elwes, P. Z. S., 1882, p. 401.

I have had considerable doubt as to the name to be given to the form of this insect found in Sikkim. It is certainly not distinguishable as a species from *melete*, of which I have numerous specimens from Amurland, Japan, and Corea, but is a rather dark mountain variety of that species analogous to the variety *bryoniæ*, which represents *P. napi* in the high Alps of Europe and in Lapland. *Melete* has, in Amurland and Japan, a summer and a spring brood, the latter of which is not at all unlike some of the smaller specimens of *melete*

found in the North-west Himalaya, but I have never seen any so large, so dark beneath, or so heavily marked with black on the veins as the form which is found in the interior of Sikkim. *Ajaka* of Moore is a form from the North-west, the figure of which does not agree exactly with anything I have seen, and though I have little doubt it is a similar insect to the Sikkim one, I cannot believe that it is distinct from *melete*. There appears to be no brood in India like the one found in Amurland and Japan in summer and autumn, and though I found *melete* in the Khasias in September not uncommonly, differing only from the Sikkim one in being less yellow on the under side, I never took this insect in the outer hills of Sikkim, where it seems to be unknown; but it is common in the interior towards Bhotan and the Chumbi valley.

379. *Pieris mesentina.*

Pieris mesentina, Cram., Pap. Ex., f. 270, A, B (1782).

Not common in the inner hills of Sikkim, but I have taken it in tea-gardens at about 3000 ft. in July, and it occurs from April to October.

380. *Pieris phryne.*

Papilio phryne, Fab., Syst. Ent, p. 473 (1775).
P. evagete, Cram., Pap. Ex., iii., t. ccxxi., figs. F, G.

A common species up to 5000 ft. throughout the season. The Sikkim form is larger and darker than those from any other locality which I have seen.

? 381. *Pieris nerissa.*

Papilio nerissa, Fab., Ent. Syst., iii., 1, p. 192 (1775).
P. amasene, Cram., Pap. Ex., t. xliv., fig. A, ♂ (1776).

Recorded by de Nicéville from Sikkim, but I have never seen a specimen.

382. *Pieris nama.*

Pieris nama, Doubl., Lep. B. M., pt. i., p. 28 (1844).
P. nama, Moore, P. Z. S., 1857, p. 102, t. 44, 1, 2, ♂ ♀.
? *P. nadina*, Lucas, Rev. et Mag. Zool., 1852, p. 335.

Common up to 3 or 4000 ft. nearly all the year round. The specimens found in the cold weather from December till March have the under side of a pale greyish brown, with hardly any green tint, and the markings almost obsolete.

383. *Tachyris paulina.*

Papilio paulina, Cram., Pap. Ex., ii., t. cx., f. E, F (1779).

Recorded by Moore from Darjeeling, but I have seen no recent specimens of this species. Moller notes it as rare in April and May at the lowest elevations, but it is an insect of the plains rather than the hills.

384. *Tachyris hippoides.*

Appias hippoides, Moore, Trans. Ent. Soc. Lond., 1881, p. 312.

This species, which is separated from the Sumatran and Javan *T. hippo* by Moore on account of the narrower dark band of the hind wing below, is very common at low elevations, 2—5000 ft., in Sikkim from March to November. My specimens agree with those from Nepal, the Khasias, and Tenasserim. The females are usually smaller than the males.

A species described as *Appias vacans* by Butler is recorded by him from Sikkim, and figured in 'Lep. Exotica,' t. 34, figs. 5, 6. This is said to be a female, and its supposed male is figured by Moore in 'Lep. Ceylon,' t. 52. I do not see any difference between this latter figure and *Appias hippoides*, and, if Butler's figure is really that of a female, can only suppose it to be an aberration of the ordinary form. I have seen nothing like it in Sikkim.

385. *Tachyris nero.*

Papilio nero, Fab., Ent. Syst., iii., 1, p. 153.

Of very rare occurrence in Sikkim, where I have never seen a specimen; but Moller has one or two from the low outer hills.

386. *Tachyris lalage.*

Pieris lalage, Doubl., Gen. Di. Lep., t. vi., fig. 5 (1847).

P. durvasa, Moore, P. Z. S., 1857, p. 103, t. 44, fig. 6, ♂.

Common at low elevations from April to October. The females, which are rarer than the males in their proper habitat, have the habit of flying up to great heights on the mountains. I took females of this species on Tonglo at 8500 ft., on the Rishilah in Bhutan at 10,400 ft., and in the Khasia hills at the highest peak on the Shillong plateau, 6400 ft.; but saw no males in any of these places. Why this very curious habit should be so marked in some species of purely tropical butterflies in Sikkim, I cannot say. It would seem to be a sort of instinct tending to decrease rather than increase the number of individuals of these species, as it is improbable that these females could regain their natural breeding-places. I shall be curious to learn whether the same habit has been noticed in other mountainous parts of India.

387. *Tachyris indra.*

Pieris indra, Moore, P. Z. S., 1857, p. 103, t. 44, fig. 5, ♀.

Tachyris indra, Wallace, Trans. Ent Soc. Lond., 1867, p. 381, ♂.

The male is not uncommon at low elevations from April to October, but the female seems much rarer, and I have not seen more than two or three specimens in Möller's collection.

388. *Eronia avatar.*

Eronia avatar, Moore, Cat. E. I. C., p. 61, t. 11*a*, f. 1, ♂ (1857).

Common up to about 5000 ft. from April to November.

389. *Eronia hippia.*

Papilio hippia, Fab., Ent. Syst., iii., 1, p. 59 (1787).

Eronia gæa, Feld., Voy. Nov., i., p. 190 (1865).

This species occurs in the Terai, and has been taken in the Tista valley in May, but is hardly to be called a hill insect.

390. *Hebomoria glaucippe.*

Papilio glaucippe, Linn., S. N., ii., p. 762.

Common up to 4 or 5000 ft. from March to November.

391. *Ixias pyrene.*

Papilio pyrene, Linn., Mus. Ulr., p. 241 (1764).
Papilio œnippe, Cram., Pap. Ex., t. cv. *c*, *d* (1779).
Papilio evippe, Don, Ill. Ex. Ent., i., t. v., fig. 2 (1773).
Papilio rhexia, Fabr., Syst. Ent., p. 476 (1775).
Thestias œnippe, Lang in P. Z. S., 1865, p. 491.
Thestias pyrenassa, Wall., Trans. Ent. Soc., 1867, p. 395, t. ix., fig. 4, ♂.

This insect is very common up to about 5000 ft. from March to December. The first brood is small, and the males vary considerably in the amount of black on the hind wings; in some cases there is absolutely none; in others it extends in the form of a macular band to the anal angle. The females of this early brood are so different from those of the later one that they could not be supposed to belong to the same species by anyone who was not acquainted with the fact that they are only found in the early spring. The broods, which come out in June, and continue flying till December, vary little in either sex. Some very interesting remarks to the same effect by Capt. Lang are referred to above; but he seems to have found the varieties to the North-west Himalaya to be rather local than seasonal, and finds great differences between those taken in the plains and the hills.

The form described as *pyrenassa*, var. A, by Wallace, from Darjeeling and Sikkit, is not exactly matched by any in my collection, but the characters by which the species is defined are very inconstant.

Wallace says that some specimens of *pyrene* from the plains of the Punjab are hardly distinguishable from some of *pyrenassa*. "The two may in fact well be considered as one abundant and variable species which has become segregated into several forms, and which may be divided into two pretty well-marked groups." I venture to think that if Mr. Wallace had had before him the numerous so-called species which have been recently described, he would have said that it was not possible to define them.

PAPILIONINÆ.

392. *Teinopalpus imperialis.*

Teinopalpus imperialis, Hope, Trans. Linn. Soc., 1843, p. 131, t. ii., figs. 1, 2; Westw., Arc. Ent., ii., t. 59 (1843).

This splendid insect is peculiar to Sikkim,* and is found only in the forest region from about 6000 to 10,000 ft. elevation. Unless its habits are known, it is most difficult to capture, on account of its remarkably strong, rapid, and darting flight, and its habit of resting on high trees, from which it flies only during a few hours of the morning, during the rare intervals of sunshine which prevail in these cloudy, damp, and rainy forests. The female, which seldom or never flies in the same places as the male, is so extremely rare that, though for many years high rewards have been offered for it to the natives who make a business of catching insects, only six or seven in all are known to have been taken, and these mostly by chance in places outside the forest.

In order to take the male, one must go early in the morning in the months of June, July, or August, to one of the few spots in the neighbourhood of Darjeeling, where a little cleared space is found on the summit of a mountain-top. Birch Hill, Sinchul, and Tonglo are all suitable places; but the top of Sinchul, called Tiger Hill, which is over 8000 ft. elevation, is the best, as it is surrounded by a large tract of virgin forest. If the morning is bright and sunny, about 8 o'clock one may expect to see *Teinopalpus* flying round the tops of the trees, and occasionally settling, but usually out of reach. The natives lay baits of some evil-smelling nature to attract the insect, as is done in Europe to attract *Apatura Iris*, and with patience and the skilful use of a long-handled net sometimes succeed in taking two or three in a morning in this manner. The insects are so strong and active in the net, however, that they are difficult to get in a perfect state, and always command a high price, even at Darjeeling. The flight is usually over by 11 a.m., even if the morning continues fine, which is very rarely

* I have just seen a specimen of *T. imperialis* from Ichang, in Central China, received by Mr. Leech.

the case during the rainy season. I have seen and taken *Teinopalpus* as high as 10,500 ft. on the top of Tonglo, and also at Tendong and Rikisum, and I believe it occurs as far eastward as Buxa. The pupa has been found by Mr. Knyvett attached to the leaves of *Daphne nipalensis*, a plant which is used for making a fine, strong paper in Nepal, and a female has been bred by him from one of these pupæ. This plant is probably the food-plant of the larva, and grows at 7—9000 ft. in the virgin forests where the insect occurs.

393. *Ornithoptera rhadamanthus.*

Ornithoptera rhadamanthus, Boisd., Sp. Gen., i., p. 180 (1836).

Common in the hot valleys at 2—3000 ft., where it flies with a slow sailing flight about the flowering trees, which it frequents from May to October.

394. *Ornithoptera pompeus.*

Ornithoptera pompeus, Cram., Pap. Ex. i., t. 25 *a* (1775).

Not so common as the last, but has a wider range of elevation, and occurs during a longer period of the year.

395. *Papilio Astorion.*

Papilio Astorion, Westw., Ann. Nat. Hist., ix., p. 37 (1842); Arc. Ent., ii., t. 66, fig. 1 (1844).
♀ *Papilio chara*, Westw., *l. c.*, p. 37, *l. c.*, fig. 2.
? *Papilio varuna*, White, Entom., i., p. 280 (1842).

This species is not uncommon in both sexes at low elevations in Sikkim, and found up to 7000 ft. It occurs from April till December. The question of priority of nomenclature is doubtful, but, bearing in mind that the female of the Malayan form or species described by White differs from the Himalayan one, and has not been found at any intermediate point, I prefer to keep it under Westwood's name, which was undoubtedly given to the Himalayan one. Seven females of the Malayan form *varuna* in the British Museum all have a distinct and well-marked whitish patch on the hind margin of the fore wing, which I have never seen in Sikkim specimens. The male also seems to differ somewhat in the

fold of the hind wing in the male, but this cannot be examined unless it is completely expanded.

396. *Papilio aidoneus.*

Papilio aidoneus, Doubl., Ann. Nat. Hist., xvi., p. 178, (1845), ♂.
Papilio erioleuca, Oberthür, Et. Ent., iv, p. 33, t. iii., 1879, ♂.
♀ *Papilio erioleuca*, de Nicéville, J. A. S. B., 1883, ii., p. 98.

This species is not uncommon in Sikkim at 2—3000 ft. from April to November, and the females, as pointed out by Mr. de Nicéville, are easily distinguished from those of *astorion* by their larger size, different ground-colour, and colour and size of the abdomen. Col. Lang was right, I think, in attributing the species to *aidoneus*, as a specimen so named, which is probably the type of *aidoneus*, exists in the British Museum, and is identical with the Sikkim insect here spoken of.

The males are easily distinguished from those of *astorion* by the very differently-shaped fold of the hind wing, and the longer and narrower shape of that wing, which has a cell shorter in proportion than is the case in *P. astorion*.

I have seen the type of *erioleuca*, Oberthür, and have no doubt whatever that it is simply the male of *aidoneus* with the anal fold of the hind wing opened out so as to show the curious pink-and-white patch of scales which are concealed beneath it. I can see no difference whatever between this and several males of *aidoneus* in my collection. The length of the cell on the hind wing of this species, which is shorter than in *astorion*, and the narrower wings, enable one to distinguish the species even when the hind wings are folded.

397. *Papilio Ravana.*

Papilio Ravana, Moore, Cat. Lep. E. I. C., i., p. 96 (1857), no description.
Papilio Philoxenus, var., Westw., Cat. Or. Ent., t. 40, fig. 4.
Papilio Philoxenus, var. D, Gray, Cat. Lep. B. M., pt. i., p. 9.

The evidence of the occurrence of this species in Sikkim is doubtful. I have two specimens from old collections marked Sikkim, and Moore's types were supposed to be from there, but no recent specimens have been procured by Möller or myself. It seems rare also in the North-west, though Capt. Young finds it in Kulu.

Note.—Since this was written, I have received, in January, 1887, but dated December, 1886, a copy of M. Oberthur's 'Etudes d'Entomologie,' Liv. xi., in which *Papilio Chentsong*, from Yerkalo, in South-east Tibet, is figured. Three months later I received Messrs. Wood-Mason's and de Nicéville's paper on butterflies of Cachar from the 'Journal of the Asiatic Society of Bengal' for 1886, pt. ii., No. 4. This is dated 1887 on the cover. In it is figured *Papilio Nevilli*, from Cachar, described by Wood-Mason in the 'Annals' for 1882, p. 105. As far as I can judge from the plates, the two species are identical, though the different way in which the hind wings are expanded gives an apparent difference to the figures. Wood-Mason says that *Nevilli* is nearly allied to *Ravana*. Oberthür says that *Chentsong* is a geographical variety of the same. The principal, if not the only, difference between these forms and *Ravana* lies in the tails, which are said to be longer and less spathulate, though in these particulars I find some variation in *Ravana*, and in the absence of the pink spot on the end of the tail, which is sometimes present above and always below in *Ravana*. If the species is distinct, it must be known under the name of *P. Nevilli*, Wood-Mason, which has priority.

398. *Papilio plutonius.*

Papilio plutonius, Oberthür, Et. Ent. ii., p. 16, t. iii., fig. 2.

Of this species I have only two females in bad condition, brought by my native shikaris from the interior, perhaps from Bhotan, in 1884. They strongly resemble small dark females of the Japanese *P. alcinous* in all but their shorter spathulate tails, and are probably the females of a western form of this species; but, as Mr. Oberthür points out, are distinguished from the nearly-allied *P. Lama*, of which he figures the female, by their

brownish green colour, and from the same sex of *Mencius*, Feld., which is the Chinese form of *alcinous*, by the shortness and form of the tails.

399. *Papilio Latreillii.*

Papilio Latreillii, Don, Nat. Rep., iv., t. 140 (1826).
Papilio minereus, Gray, Zool. Misc., p. 32 (1831); Lep. Nepal, p. 5, t. i. (1846).

A not uncommon species at 7—9000 ft. in Sikkim, where I have several times seen and taken it on Jellapahar, on Sinchul, and the Goompahar ridge. It frequents dense forest, where it flies high over the tops of the trees, from April or even sooner on into July and August, when most of the females are worn and much broken. It may best be taken, like most of the high-flying forest-insects, by waiting on a sunny day at an open space at the top of a hill, or when it occasionally comes down to settle on the path.

I am not aware why Donovan's name for this species, which has priority over Gray's, has been generally ignored by recent writers, except Kirby. The plate, though not a good one, is, I think, quite unmistakeable.

400. *Papilio dasarada.*

Papilio dasarada, Moore, Cat. Lep. E. I. C., p. 96 (1857), no description.
Papilio Philoxenus, var., Westw., Cat. Or. Ent., t. 40, fig. 5.

This form, which was separated from *Philoxenus* by Moore, is a larger and probably distinct species, which occurs not uncommonly in Sikkim, Bhotan, and the Khasia hills. In Sikkim it seems rarer than *Philoxenus*, and is found from 1 up to 8000 ft., and from April till November. It may be distinguished almost invariably by the single large white spot between the second subcostal and discoidal nervules of the upper hind wing, which is not accompanied, as in *Philoxenus*, by a smaller white spot below it; on the under hind wing there is an additional spot of variable size above the large one between the first and second subcostal nervules, which is present in one only out of fourteen specimens of *Philoxenus*. There are also marked differences between

the pink lunules of the hind wing, and I think the abdominal fold is less developed in *dasarada*. I have not observed in this species the nauseous odour which, according to Wood-Mason, is characteristic of *Philoxenus*, but Mr. de Nicéville says it has the strongest smell of any butterfly he knows. The flight of this butterfly is much less swift than that of many Papilios. It may be seen sailing with a very soft, graceful flight along the edge of the clearings and round the flowering trees in the open places. A species of *Albizzia* is one of its favourite trees, but to get fresh specimens one must search for those which, having recently emerged from the pupa, may be found settled on the low herbage and flowers at the side of the forest-path.

401. *Papilio philoxenus*.

Papilio philoxenus, Gray, Zool. Misc., p. 32 (1831); Lep. Nepal, p. 5, t. 2, ♀ (1846).
Papilio polyeuctes, Doubl., Gray's Zool. Misc., p. 74; Di. Lep., t. ii., fig. 3, ♂; Westw., Cat. Or. Ent., t. iv. *a*, fig. 3.

This species seems to have a much wider range than the last, as I have specimens from Hazara, in the extreme N.W. Himalaya, to Mooleyit, in Tenasserim. It is common in Sikkim at the same elevations and in the same months as the last, but I am unable to say whether the species mix together.

402. *Papilio Janaka*.

Papilio Janaka, Moore, Cat. Lep. E. I. C., i., p. 97 (1857); P. Z. S., 1857, p. 104, t. 45.
? *P. sikkimensis*, Wood-Mason, Ann. Nat. Hist., 1882, p. 103.

A rather rare species in Sikkim, where it is found at 3—5000 ft. in May and June. I am doubtful whether *P. sikkimensis* is really distinct or not. Mr. Wood-Mason describes it as having the fore wings and basal half of the hind wings of a greenish black, which is not the case in any specimens I have seen from Sikkim. He does not, however, give any comparison of it with *Janaka*, and as only one species is known to us in Sikkim to which these two names can be applied, I cannot help

thinking some change of colour may have taken place. The males vary considerably in the number and position of the white patches on the hind wing, which are normally three in number; but the outer one is sometimes wanting, and an additional one is sometimes found towards the abdominal angle. The female is unknown to me.

403. *Papilio aristolochiæ.*

Papilio aristolochiæ, Cram., Pap. Ex., ii., t. 128, *a*, *b* (1779).

Common up to 2 or 3000 ft. from April to December.

404. *Papilio paris.*

Papilio paris, Linn., Mus. Ulr., p. 184 (1764).

The commonest of the green Papilios in the low valleys, and taken up to 5000 ft. Settles on flower-heads, and the damp sand in river-beds, and flies rapidly up and down their banks. The female is very seldom taken, but does not differ from the male, except in its paler coloration.

405. *Papilio Krishna.*

Papilio krishna, Moore, Cat. Lep. E. I. C., p. 108, t. 2*a* (1857).

A common species in some seasons at certain places, and found from 3 up to 8 or 9000 ft., but hard to catch in good condition. I have seen it most often on or about the bare tops of hills, like Sinchul, which are clothed with dense chestnut, oak, and magnolia forest, in which it probably lives and breeds, and comes out on sunny mornings into the openings, where alone it can be taken. The female is extremely rare, only one or two specimens being known to us. Its season is from May to August.

406. *Papilio arcturus.*

Papilio arcturus, Westw., Ann. Nat. Hist., ix., p. 37 (1842); Arc. Ent., i., t. xxvii. (1843).

Found in very similar places at the same time of year, and has very similar habits to the last, but less abundant

as a rule. I have sometimes seen it in the forest-paths, where it occasionally settles. The female is also rare, but does not differ from the male, except in being rather larger.

407. *Papilio ganesa.*

Papilio ganesa, Doubl., Gray, Zool. Misc., p. 73 (1842); Gray, Cat. Lep. B. M., i., p. 16, t. iii.

This is an inhabitant of the lower valleys, like *P. paris*, and occurs from April to December in successive broods, whilst *arcturus* and *krishna* are probably single-brooded.

408. *Papilio androgeus.*

Papilio androgeus, Cram., Pap. Ex., t. 91, f. *a*, *b* (1779).

Common in the lower valleys, and found as high as 4 or 5000 ft. from April until December. The common form of female in Sikkim is tailed, with a considerable amount of white in and beyond the cell of the hind wing; but tailless females are also found without any white markings, and others with a broad white patch on the hinder margin of the fore wing.

409. *Papilio protenor.*

Papilio protenor, Cram., Pap. Ex., i., t. 49 (1779).

Möller records this species as occurring from 2 to 3000 ft., and from April until October; but it occurs at much higher elevations in the N.W. Himalaya, and in Khasia I have seen it up to at least 6000 ft. It is not, however, so common in Sikkim as in some other parts of the Himalaya, and the female is decidedly rare. I have never taken it myself in Sikkim.

410. *Papilio Rhetenor.*

Papilio Rhetenor, Westw., Arc. Ent., i., t. xvi. (1842).
♀ *Papilio Icarius*, Westw., Cab. Or. Ent., t. 2 (1848).

Found not uncommonly in the lower valleys, and up to 5 or 6000 ft. from April to October. Two forms of the male exist, which I am not able to separate, except by the colour of the hind margin of the fore wing, which in one form is more or less overlaid with grey or white

scales close to the angle. There is also some variation in the white lunules which are present at the abdominal angle of the hind wing, and in some specimens show more or less on the upper surface. The female form described as *Icarius* is, without doubt, the female of this species. It is rare in Sikkim.

411. *Papilio helenus.*

Papilio helenus, Linn., Mus. Ulr., p. 185 (1764).

One of the commonest species of *Papilio* at all elevations up to 5 or 6000 ft., but most numerous in the low valleys from April till October.

412. *Papilio chaon.*

Papilio chaon, Westw., Arc. Ent., ii., t. 72, fig. 1 (1845).

Not uncommon in the low valleys, and often seen flying up and down the course of the rivers, in company with *helenus* and many other species, from April on till October.

413. *Papilio polytes.*

Papilio polytes, Linn., Mus. Ulr., p. 186 (1764).
Papilio pammon, Linn., *l. c.*, p. 189.

Found in Sikkim at low elevations only, and not so common as in the plains, from March all through the year.

414. *Papilio erithonius.*

Papilio erithonius, Cram., Pap. Ex., iii., t. 232 A, B (1782).

Rather a species of the plains than the hills, and only found in the Terai and outer hills at low elevations.

415. *Papilio Slateri.*

Papilio Slateri, Hew., Ex. Butt., ii., Pap., t. 4 (1859).

This is a very rare species, which I have never seen in Sikkim. It seems only to occur in the outer hills at a very low elevation, and the few specimens Moller has procured were taken at Sivoke in May. Moller describes the female as having the wings conspicuously broader,

and the colour a shade paler than the male, but otherwise like it.

416. *Papilio polymnestor.*

Papilio polymnestor, Cram., Pap. Ex., i., t. 53 A (1779).

A single specimen only of this species was taken in 1887 by Moller's collectors, probably a straggler from the plains.

417. *Papilio clytia.*

Papilio Clytia, Linn., Mus. Ulv., p. 296 (1764).
Papilio dissimilis, Linn., *l. c.*, p. 301.

A common species from the plains up to 3000 ft., and occurs from March till November. I am assured by Mr. Aitken, of Bombay, who has bred this species, that *clytia* and *panope* are produced from similar larvæ found together, and are probably two forms of one species.*

418. *Papilio panope.*

Papilio panope, Linn., Syst. Nat., i., 2, p. 782 (1767).

Common at the same elevation and same season as the last.

?419. *Papilio megarus.*

Papilio megarus, Westw., Arc. Ent., ii., t. 72 (1845).

I have no direct evidence of the existence of this species in Sikkim, and though a single specimen of it in my old collection bears a Sikkim label, Möller has never obtained it there.

420. *Papilio xenocles.*

Papilio xenocles, Doubl., Gray, Zool. Misc., p. 74 (1842); Hew., Gen. D. L., t. i., fig. 2.

A common species in the lower valleys up to 3000 ft.,

* In the 'Journal' of the Bombay Natural History Society, No. 1, vol. ii., 1887, p. 37, the following passage occurs:—"Among the larvæ of the last species (*dissimilis*) which I reared was one not distinguishable from the rest, which to my astonishment turned into this (*? panope*). I am quite satisfied that the two are one species. I have never recognised another specimen of *panope* in this Presidency, but have little doubt that I have often let it pass for *E. core*." (Aitken).

from April till November. Females are rare, and differ slightly.

421. *Papilio macareus.*

? *Papilio macareus*, Godt., Enc. Méth., ix., p. 76 (1819).

The form of *P. macareus* found in Sikkim is so different from the Bornean one, that I hardly like to retain the same name for it. It differs materially in the much greater breadth of the whitish bands on both surfaces of both wings, in the much more abundant hairy clothing of the abdominal margin, and in the smaller size; in all these respects agreeing better with Tenasserim and Burmese specimens, though some of these have the bands narrower than Sikkim specimens. It is not uncommon at low elevations during the months of May and June, but the females, as in the case of so many species of *Papilio*, are extremely rare.

422. *Papilio agestor.*

Papilio agestor, Gray, Zool. Misc., p. 32 (1831); Lep. Nepal, p. 6, t. 4 (1846).
P. agestor, Westw., Arc. Ent., p. 59, t. 16, fig. 2.
? Var. *P. govindra*, Moore, P. Z. S., 1865. p. 486.
♀, *Cadugoides gopala*, Moore, P. Z. S., 1882, p. 260.

This is a rare species in Sikkim, which I have never seen myself, but Möller has taken it on Birch Hill at 6—7000 ft. in May, and records it from a lower elevation in April as well. I can hardly tell whether the North-western form which Mr. Moore has separated as *govindra* is distinct or not, as, though four specimens from Landour are easily distinguished by their smaller size, different tint, and dark outer margins of the hind wings, yet the differences are just those which might be expected to be produced by a colder climate, or in an earlier brood, supposing there are two. *P. agestor* also occurs in the North-west, and in the same localities as *govindra.* I have it from Kangra and Landour, but I do not know whether it appears in the rains or dry weather. I have a female from Chumba in April, which agrees with Mr. Moore's *C. gopala*, and which is clearly inseparable; but as it appears to combine the characters of both forms, I do not know to which to assign it, as I have no

females from Landour or Sikkim. I have, however, a female of *agestor* from Bhotan which resembles it in all but the dark markings on the margin of the hind wings. M. de Niceville and Moller believe that, both at Simla and in Sikkim, *P. govindra* and *P. agestor* are single-brooded, and occur in spring only, and I have seen no males like *govindra* from Sikkim.*

423. *Papilio epycides.*

Papilio epycides, Hew., Ex. Butt., ii., *Pap.*, t. 6, fig. 16 (1864.

Occurs not uncommonly in some seasons at 2 to 3000 ft. in April and May. The female is unknown to me, but is described by Moller as like the male, but with broader wings, and all the white markings comparatively larger. This species seems to have been found nowhere but in Sikkim, and is said by Moller to frequent the sandy beds of streams, like other species of the genus, and to be single-brooded.

424. *Papilio Glycerion.*

Papilio Glycerion, Gray, Zool. Misc., p. 32 (1831); Lep. Nepal, p. 6, t. 3 (1846).

This species is not very abundant in Sikkim, but occurs at about 2—4000 ft. elevation in May and June. I saw it on several occasions in the valleys below Mongpo in those months, but found it difficult to take, on account of its very quick flight.

425. *Papilio paphus.*

Papilio paphus, de Nicé., J. A. S. B., 1886, pt. ii., p. 254, t. xi., fig. vi.

This species has been in my collection as distinct from *Glycerion* for some years, but, excepting Dr. Staudinger, I do not know that anyone else had distinguished it from

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* Moller describes the female in Sikkim as like the male, but the wings conspicuously ampler (? broader), markings as in the male, except that the marginal row of spots on the fore wings and arrow-shaped marks on the hind wing are larger and more prominent.

that species.* Whether it was more abundant in Sikkim in 1886 than formerly, or not, I cannot say, but at least a dozen male specimens were taken in May, June, and July, some of them near Mongpo and some on the top of Sinchul. Mr. Möller says its range is from 3 to 7000 ft., but, as far as I can judge, it is found at higher elevations than *Glycerion*, and is more of a temperate than a tropical species.

None of the specimens I have seen show the slightest tendency to vary, and the pattern of the hind wing below, well-figured by Mr. de Nicéville, distinguishes it with certainty from *Glycerion*. The females of both these species are unknown to me.

426. *Papilio agetes.*

Papilio agetes, Westw., Arc. Ent., ii., t. 55, fig. 3 (1843).

A rare species, which I have never seen in life. Möller notes it as occurring at Sivoke, where the Teesta debouches into the plains, in April and May.

427. *Papilio antiphates.*

Papilio antiphates, Cram., Pap. Ex., i., t. 72 (1779).
Papilio antiphates, var. *pompilius*, Fab., Dist., Rhop. Mal., p. 327, t. xxxi., fig. 5.

Common in the lower valleys up to 3000 ft. from April till October. The characters by which Mr. Butler attempts to separate the forms of this species, and quoted by Distant, seem, in my series of sixteen specimens,—two from Borneo, one from Canton, six from Sikkim, one from Cachar, and six from Tenasserim and Tavoy,—too variable to be relied on. The Sikkim specimens, however, have the fourth costal triangular band short, not reaching more than half across the cell.

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* I recognised in his collection what I believe to be the same insect as *paphus* with the MSS. name of *Glycerides*. M. Oberthür has also described, in Et. Ent., Liv. iv., p. 115, an eastern form of *Glycerion* from Moupin, which he calls *mandarinus*, distinguished by the pattern of the under side being reproduced above; whilst in *Glycerion* it only shows through the transparence of the wing.

428. *Papilio anticrates.*

Papilio anticrates, Doubl., Ann. Nat. Hist., p. 371 (1846); Gray, Cat. Lep. B. M., p. 29, t. 3 (1852).

Rare in the lowest valleys of Sikkim, but found in abundance by Möller's collectors at Sivoke in May. The bands across the cell of hind wing in these specimens is almost obsolete, which distinguishes them readily from Tenasserim specimens, and the Assam form figured by Doubleday is also different in this respect. The second band on the fore wings is also shorter. I do not know how the form or species described as *orestes*, Fab., and which is quoted by Felder as occurring in Sikkim, differs, and whether *Nomius*, Esp., of which *orestes* has been considered a synonym, ever occurs in the Sikkim Terai or not.*

429. *Papilio cloanthus.*

Papilio cloanthus, Westw., Arc. Ent., i., t. ii. (1842); Kollar, Hugel's Kash., i., p. 405, t. 2 (1848).

Möller gives the habitat of this species as from 2—4000 ft., and its occurrence as from April till October, but I should consider it as rather a temperate than a tropical butterfly, having only seen it at about 6000 ft. Capt. Lang says in the N.W. Himalaya it occurs from 5 to 7000 ft., and Doherty found it in Kumaon from 2 to 7000 ft. I saw it in Khasia at 6000 ft., flying on sunny days round the tops of trees with very rapid flight, and hard to catch.

430. *Papilio sarpedon.*

Papilio sarpedon, Linn., Mus. Ulr., p. 196 (1764).

Common in Sikkim at low elevations, and occurs up to 7000 ft. between April and October. A very strong flyer, and only caught when settled on wet places in the sun.

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* The female, which was hitherto unknown, is thus described by Moller:—"Expanse, 3·06 in. Like the male, but with broader wings. The black band next to the basal band on the fore wing, which in the male goes right across to the hind margin, stops short in the female at the submedian nervure. The next band across the discoidal cell reaches only to the median nervure, whilst in the male it goes a little beyond it."

431. *Papilio eurypilus.*

Papilio Eurypilus, Linn., Syst. Nat., ed. x., p. 464 (1758); Clerck's Icones, ii., t. xxviii., fig. 2 (1764).
P. eurypilus, Wood-Mason & de Nicé., J. A. S. B., 1886, p. 375.
P. telephus, Feld., Reise Nov., i., p. 64 (1865); Dist., Rhop. Mal., p. 361, fig. 109.
P. mecisteus, Dist., Rhop. Mal., p. 361, fig. 108.
? *P. doson*, Feld., Verh. Zool. Bot. Ges., xiv., p. 305 (1864); Moore, Lep. Cey., p. 145, t. 61, 3.

Common in the low valleys from April to October. In identifying the Sikkim form with *P. Eurypilus* of Linnæus I follow Messrs. Wood-Mason and de Nicéville, who say that the one found in Cachar agree with Clerck's figure of the type of this species, except in being a little larger, and have the discal macular band even wider. Distant says that the typical *Eurypilus* is found in the eastern islands of the Malay Archipelago, and, not satisfied with the numerous names which the older authors and Felder have already given it, adds another. My own series contains four specimens from Sikkim, three from Bhotan, one from Cachar, one from Calcutta, three from the Andaman Islands, three from the Nilghiri hills, four from Tenasserim, and four from the hills on the frontier of Siam and Burmah. Among these I find no constancy. The Himalayan, Cachar, and Andaman specimens are generally rather larger, and have broader bands than those from S. India, Tenasserim, and Siam, which have been distinguished as *telephus* and *doson*. The character by which *mecisteus* is distinguished, namely, the junction of the short red-spotted costal band of the hind wing below with the longitudinal band of the inner margin, is variable, especially in Sikkim specimens. Before the various names quoted above can be recognised by me as distinct species, it will be necessary for those who make no allowance for variation to define the various forms, and show that they are confined to certain areas.

432. *Papilio bathycles* var. *chiron.*

Papilio bathycles, Zincken-Sommer, Nova Acta Ac. Nat. Cur., xv., p. 157, t. 14, 6, 7 (1837); Wall., Trans. Linn. Soc., xxv., p. 66 (1865); Dist., Rhop. Mal., p. 362, t. xxxii., 2.

P. Bathycles, Guer., Belang. Voy. Ind. Or. Ins., p. 505, t. v., figs. 1, 1*a* (1844).

Var. ? *chiron*, Wall., Trans. Linn. Soc., xxv., p. 66 (1865).

Var. *bathycloides*, Honr., Berl. Ent. Zeit., xxviii., p. 396, t. x., 3 (1884).

Var. *chironides*, Honr., *l. c.*, p. 397, t. x., 4.

The form of *bathycles*, which occurs not uncommonly in Nepal, Sikkim, Bhotan, and the Khasias, but which is not included in the list of Cachar butterflies by Messrs. Wood-Mason and de Nicéville, or in that of Tenasserim butterflies by Moore, was separated by Wallace under the name of *P. chiron*, but though I have not been able to compare large series of the Himalayan form with a corresponding number from the Malay peninsula and islands, I do not see that the points relied on by Wallace are of specific value. And though it might be possible to distinguish the typical specimens of *chiron* from typical specimens of *bathycles* with certainty, yet we have the same difficulty which occurs in so many wide-ranging species, of intermediate forms and varieties which combine more or less of the characters of both extremes. Distant's figure of *bathycles*, when compared with my Sikkim specimens, is such an intermediate, and Honrath adds further to the strength of my argument by figuring what he calls var. *bathycloides* from Malacca and Borneo, which he separates from *Bathycles* of Java, as well as *chironides*, which he says occurs with *chiron* in Sikkim. If we begin to pick out of a large series specimens to match these figures in the way which Mr. Moore commonly does, we shall find ourselves left with a number which belong strictly to none of them, and though *chiron* is not in Sikkim subject to much variation, yet I cannot see good grounds for separating it at present. The male is not uncommon at 2—3000 ft. from April to October, but I have never seen the female.

433. *Papilio agamemnon.*

Papilio agamemnon, Linn., Mus. Ulr., p. 202 (1764).

Common up to 3000 ft. from April till December.

434. *Papilio Gyas.*

Papilio Gyas, Westw., Arc. Ent., i., t. xi. (1841).

This is a decidedly rare species in Sikkim. I have seen it once only flying round the top of a hill at 6000 ft. at Rikisum in August. Möller has seen it on Birch hill at 7000 ft. in July, and Mr. Knyvett has taken the very rare female on Sinchul in August. It seems therefore to be a single-brooded species, inhabiting the same zone of elevation as most of the peculiar Sikkim species do. The female, which has never been described, differs very markedly from the male in its pale whitish colour above.

435. *Papilio machaon.*

Papilio machaon, L., var. *asiatica*, Mén., Cat. Mus. Petr., i., p. 70 (1855); Elwes, P. Z. S., 1882, p. 399, cf. Hagen, *Papilio*, ii., p. 151 (1882).

P. Sikkimensis, Moore, J. A. S. B., 1884, p. 32.

Neither Möller or myself have ever seen this species in British Sikkim, and I believe it only occurs in the higher, dryer hills of the interior, whence our native skikaris have brought very numerous specimens in July and August.

The interesting papers on the varieties of this species by Prof. Hagen and Mr. W. H. Edwards in *Papilio*, 1882 and 1883 show how hard it is to come to any just conclusion as to the variation of wide-ranging species like *machaon*; but I see no reason to alter what I formerly said as to the Sikkim form, *viz.*, that it is darker and more heavily marked than in Europe, smaller and more uniform in colour than in Japan. It must be remembered that only one brood is found, as far as we know, in the Eastern Himalaya, and that at a great elevation, probably from 8 or 10 to 12,000 ft. and upwards.

436. *Papilio castor.*

Papilio castor, Westw., Ann. Mag. Nat. Hist., ix., p. 37 (1842); Arc. Ent., ii., t. 80 (1848).

♀, *P. pollux*, Westw., *l. c.*

Not uncommon up to 2 or 3000 ft. from April till October, but the females are less often procured than the males.

PARNASSIINÆ.

437. *Parnassius Hardwickei.*

Parnassius Hardwickei, Gray, Cat. Lep. B. M., p. 76, t. xii., figs. 8—11 (1852); Elwes, P. Z. S., 1886, p. 38.

Not uncommon in the higher ranges of the interior, but not obtained in British Sikkim.

438. *Parnassius Jacquemontii.*

Parnassius Jacquemontii, Boisd., Sp. Gen., p. 400 (1836), in part, ♀.
P. epaphus var. *sikkimensis*, Elwes, P. Z. S., 1882, p. 399, t. xxv., figs. 4—6.
P. Jacquemontii, Elwes, P. Z. S., 1886, p. 36, t. ii., fig. 1.

Occurs at great elevations in the interior. I have taken it myself in September as high as 18,000 ft. near the Donkia pass. I do not now see anything to distinguish the Sikkim insect from that found in the North-west, excepting its smaller size.

439. *Parnassius acco.*

Parnassius acco, Gray, Cat. Lep. B. M., i., p. 76, t. xii., figs. 5, 6 (1852).
P. acco, Elwes, P. Z. S., 1882, p. 400; P. Z. S., 1886, p. 35.

The single specimen, which I formerly mentioned as having been received with the last species from native collectors in the Chumbi valley, remains unique as regards this part of the Himalayas.

HESPERIDÆ.

440. *Badamia exclamationis.*

Papilio Exclamationis, Fabr., Syst. Ent., p. 530 (1775).

Common up to about 6000 ft. from April to October. Varies considerably in size and in the number and size of the spots on the fore wing.

441. *Choaspes Benjamini.*

Thymele Benjamini, Guer., Del. Souv. Ind., ii., p. 79, t. 22, fig. 2 (1843).
Hesperia xanthopogon, Koll., Hügel's Kash., p. 453, t. xviii. (1844).

Not a common species, but found up to 7000 ft. from April to October. I have only seen it in virgin forest at 6000 ft., where, owing to its rapid flight, it is very hard to take. It is larger and brighter in Sikkim than in Japan, and is somewhat variable in colour, some specimens being of a much darker green than others, which show a bluish tinge.

442. *Choaspes gomata.*

Ismene gomata, Moore, P. Z. S., 1865, p. 783.
Choaspes gomata, de Nicé., J. A. S. B., 1883, p. 83, t. x., fig. 7, ♀.

Not a common species, frequenting the valleys up to 3000 ft. between May and October. The female is unknown to me, though described by de Nicéville from the Wynaad.

443. *Choaspes harisa.*

Ismene harisa, Moore, P. Z. S., 1865, p. 782.
Choaspes harisa, de Nicé., J. A. S. B., 1883, t. x., fig. 8, ♂.

Found with the last; not common. Moore describes the female as dark purple-brown, the base of wings greyish, with steel-blue gloss; but either his specimen was very worn, or he was describing another species. A single fresh and perfect female in my collection is blackish brown, brilliantly glossed over with steely green, which extends nearly to the border of the hind wing and over more than half of the fore wing. It has no costal streak like the male.

444. *Choaspes ? anadi.*

Choaspes ? anadi, de Nice., J. A. S. B., 1883, p. 83, t. x., fig. 6, ♂.

A rare species found by Möller's collectors, which seems most nearly allied to *C. harisa*, but differs in the

fore wing being much narrower, and the pale costal patch on the hind wing much more restricted. The female, however, is much more like the male than in the case of *harisa*.

445. *Choaspes vasutana.*

Ismene vasutana, Moore, P. Z. S., 1865, p. 782.

Rare at the same elevations and seasons as the last two. The male in three cases out of five has on the upper side indications of the two glossy spots on the fore wing which are usually seen in the female, though some have only one, and all of my specimens show them on the under side. My only female specimen has the inner half of the wings glossed with bright, steely, greyish blue-green, as in *harisa*. The thorax is covered with hairs of the same colour, but de Nicéville says that in his specimens the upper side of both wings is clothed with rich orange setæ, without any trace of bluish green. If he has correctly identified his specimens the female must therefore be dimorphic.

446. *Choaspes amara.*

Ismene amara, Moore, P. Z. S., 1865, p. 783.

Found up to 3000 ft. during the summer months. I have not seen the female, which is described by Moore as like the male.

447. *Ismene œdipodea.*

Ismene œdipodea, Swains., Zool. Ill., i., t. 16, 1820—1.

Rare in Sikkim, where it occurs with the previous species at low elevations. I have two pairs of this species from Hocking's Kangra collection. The male from Sikkim differs from these in having the costal margin of the hind wing above distinctly white. The black velvety sexual patch is very distinct, whereas in the next species it is faint. This species was described from Sumatra, but I have not been able to compare it with specimens from that country.

448. *Ismene jaina.*

Ismene jaina, Moore, P. Z. S., 1865, p. 782.

A larger insect than the last, and, like it, rare in the

hot valleys. I have only males, but the female is said by Moore to be without the red costal streak, which in the female of *ædipodea* is present.

449. *Pirdana Rudolphei.*

Pirdana Rudolphei, de Nicé., J. A. S. B., 1887, p. 438, t. xx., fig. 6, ♂.

Described from a single female in Col. Lang's collection, taken in Sikkim by the late Dr. Jerdon. A male also from Tavoy.

450. *Hasora badra.*

Goniloba badra, Moore, P. Z. S., 1865, p. 778.
Hasora badra, Dist., Rhop. Mal., p. 374, t. xxxv., fig. 3, ♂.

Common up to 4000 ft. from April to November.

451. *Hasora alexis.*

? *Papilio alexis*, Fabr., Syst. Ent. p. 533 (1775).
Parata alexis, Moore, Lep. Ceyl., p. 161, t. 65, fig. 2, *a*, *b*.
Papilio chromus, Cram., Pap. Ex., iii., t. 284, E (1782?).

Not uncommon in the low valleys and up to 5000 ft. during the rains. I cannot distinguish between what Moore figures as *alexis* and *chromus*. He says of the Ceylon *alexis*, " Smaller than *chromus*, with broader and more prominently marked band on the under side of the hind wing." I have a large series of specimens, including two males and a female from Ceylon, one pair from Bangalore, four pairs from Sikkim, one male and two females from Andaman Islands, one pair from Shillong, one male from Barrackpur, and two males from Burmah; but I find too much variation in the size and in the band of the under side to allow me to separate two forms. De Nicéville considers them distinct, and says that *alexis* occurs only in South India and Ceylon. If, however, they are identical, *alexis*, being the older name, should be used; and, if they are distinct, the Sikkim form will bear the name of *chromus*.

452. *Bibasis sena.*

Goniloba sena, Moore, Cat. E. I. C., p. 245 (1857).
Bibasis sena, Moore, Lep. Ceyl., p. 160, t. 65, figs. 3, 3 *a*.

A rare species in Sikkim, but seems commoner in Assam.

453. *Matapa aria.*

Ismene aria, Moore, P. Z. S., 1865, p. 784.
Hesperia aria, Hew., Ex. Butt., iv., Hesp., iii., figs. 22, 25 ♀ (1868).

Möller has found this species only in the Terai. It is a much smaller insect than *shalgrama*, which occurs in the lower hills, as well as the Terai.

454. *Matapa shalgrama.*

Matapa shalgrama, de Nicé., J. A. S. B., 1883, p. 85.

Not uncommon up to 3 or 4000 ft. from April to October.

455. *Matapa sasivarna.*

Ismene ? sasivarna, Moore, P. Z. S., 1865, p. 784.

Rarer than the last, in similar localities and seasons. The female differs in having somewhat longer wings and no sexual streak.

456. *Matapa druna.*

Ismene druna, Moore, P. Z. S., 1865, p. 784.

Noted by Moller as occurring up to 3000 ft. from April to October, but not at all common.

457. *Capila jayadeva.*

Capila jayadeva, Moore, P. Z. S., 1865, p. 785, t. xlii., fig. 3.

A rare species at low elevations, taken between April and October. The female is without the orange on the thorax and base of wings, and has much broader, rounder wings than the male.

458. *Pizzola zennara.*

Pizzola zennara, Moore, P. Z. S., 1865, p. 786, t. xlii., fig. 4.

Still rarer than the last, and found between April and August in the low valleys. The antennæ of the female are much less hooked at the tip than those of the male, a character also found in *C. jayadeva*.

459. *Pithauria murdava.*

Hesperia murdava, Moore, P. Z. S., 1865, p. 784; *l. c.*, 1878, p. 689, t. xlv., fig. 13.

Not uncommon up to 3000 ft. from May to October.

460. *Pithauria stramineipennis.*

Pithauria stramineipennis, Wood-Mason & de Nicé., J. A S. B., 1886, p. 388, t. xv, 5, ♂.

P. murdava, Dist., Rhop. Mal., p. 378, t. xxxv., 9, ♂.

Differs from *murdava* in the lighter straw-colour, not yellowish olivaceous, as in *murdava*. It has been treated by Moore as the female of *murdava*, but the females of both species are known to de Nicéville, and are in my collection. That of *murdava* differs in having the darker wings richly purple-glossed, and in the very scanty setulose clothing at the base, conforming in colour to the male. It is also not uncommon at low elevations.

461. *Baoris oceia.*

Pamphila oceia, Hew., Desc. Hesp., p. 31, No. 22 (1868).

Hesperia oceia, Wood-Mason & de Nicé., J. A. S. B., 1881, p. 258

Baoris unicolor, Moore, P. Z S., 1883, p. 533; de Nicé., J. A. S. B., 1883, t. x., fig. 11, ♀.

B. scopulifera, Moore, *l. c.*, p. 332.

This species is the type of a genus in which the male has a conspicuous patch of velvety hairs on the centre of the hind wing. Both sexes vary very much in Sikkim, as in the Andamans. Of seven males in my collection, no two specimens agree in the number of spots. Of six females, three are spotless, as in *unicolor*, Moore; the other three have from five to eight spots on the fore wing. It seems incredible that Moore should have given two new names to this species without the slightest reference to the minute description of these variations given by Wood-Mason and de Nicéville. It is common up to 4 or 5000 ft. during the greater part of the season.

462. *Chapra mathias.*

Hesperia mathias, Fabr., Ent. Syst., Suppl., p. 433 (1798); Butl., Cat. Fabr. Lep. B. M., p. 275, t. 3, fig. 8, ♂.
H. agna, Moore, P. Z. S., 1865, p. 791.
? *Pamphila subochracea*, Moore, P. Z. S., 1878, p. 691; Wood-Mason and de Nicé., J. A. S. B., 1887, p. 384.

This species, which occurs up to 7 or 8000 ft. from April to December in Sikkim, is distinguished in the male sex by a brand on the fore wing characteristic of the genus, and in both sexes by a spot on the middle of the under side of the hind wing near the base. In some examples a spot or more shows on the upper side of the hind wing. I have it from China, Japan, and almost all parts of India. *H. agna*, of which I have numerous specimens from the Bombay Presidency, seems identical, and though some supposed differences are pointed out in the 'Lepidoptera of Ceylon,' I think it impossible to recognise them as distinct.

463. *Chapra prominens.*

Chapra prominens, Moore, P. Z. S., 1882, p. 261.
? *Gegenes sinensis*, Mab., Bull. Soc. Zool. France, 1877, p. 232.

A common species in Sikkim up to about 5000 ft. from April to October. I have taken it in virgin forest at 7000 ft., as well as at low elevations in sunny places. The sexual brand is conspicuous in the male. In the female there are two additional spots near the hind margin of the fore wing.

PARNARA, *Moore*, Lep. Ceylon, i., p. 166.

The numerous species of *Parnara* which occur in Sikkim and elsewhere are very difficult to distinguish, unless a numerous series of both sexes, in good condition and well-set, are examined in a good light; and, as I have been able to do this, mainly owing to the Sikkim specimens collected by Möller, I shall now endeavour to

make it possible for others to know the species when they got them.

Though an anatomical examination may possibly change this arrangement, I think it will be found accurate as far as it goes, and probably other insects, not now included in the genus, may be found to belong to it.

The type of the genus is *Eudamus guttatus*, Brem., a species which, though occurring in Japan and North China, has not been included in the excellent monograph of the Genera of Palæarctic *Hesperidæ*, by Dr. Speyer, Stett. Ent. Zeit., 1878, p. 167; and 1879, p. 477.

464. *Parnara guttatus.*

Eudamus guttatus, Brem., Grey. Schmett. N. China, p. 10 (1853).

Goniloba guttatus, Men., Cat. Mus. Petr. i., t. v., fig. 4 (1855).

Pamphila mangala, Moore, P. Z. S., 1865, p. 792.

? *Hesperia bada*, Moore, P. Z. S., 1878, p. 688.

? *Pamphila fortunei*, Feld., Verh. z B. Ges., xii., p. 489 (1862); Reise Nov., t. 72, fig. 11.

I have specimens from Shanghai (*Pryer*), Japan (*Leech*), Kashmir (*Stoliczka*), named *mangala* by Moore, from Mandi (*Young*), Sikkim (*Elwes & Möller*), which all agree very well. They may be known by the nearly straight line of four transparent spots on the hind wing, and the curved discal series of six or sometimes only five spots on the fore wing, as well as two, one or both of which are sometimes wanting, in the cell.

Parnara bada, Moore, of which I have specimens from Cachar, Bombay, Poona, Sikkim, and Ceylon, and which also occurs in Malacca, is distinguished by the less conspicuous markings on the hind wing, usually smaller size, and absence of the two spots in the cell; but I am not sure that these characters are constant. *P. guttatus* occurs in Sikkim up to about 7000 ft. during the whole season, and at Mandi up to 6000 ft. from April to October. It seems, however, to be commonest at low elevations. The female hardly differs.

465. *Parnara colaca.*

Parnara colaca, Moore, P. Z. S., 1877, p. 594, t. lviii., fig. 7.

This species is so near *P. beavani*, Moore, that I hardly know whether it will prove distinct, but both Möller and myself think we can recognise two forms in Sikkim, and though the figure of *colaca* is bad, and the description of little help, yet I have specimens from the Andamans, from whence *colaca* was described, which agree with the Sikkim insect. It may be known from *beavani* by its longer fore wings and differently shaped hind wings, and by the spots on the upper side of fore wing and under side of hind wing being different in number and position, though in neither form is this character constant. These differences are shown in the

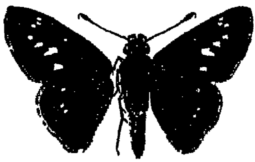

FIG. 1.—*Parnara colaca.*

woodcut (fig. 1). This form is found at low elevations in Sikkim, but seems less common than the next. In Cachar it is common, according to de Nicéville.

466. *Parnara beavani.*

Hesperia beavani, Moore, P. Z. S., 1878, p. 688.

The description of this species is not of much use, and there is no figure; but I have a specimen from Sikkim named by Moore, and numerous others of both sexes from Mandi, N.W. Himalayas (*Young*), Khasias (*Elwes*), and Sikkim (*Elwes & Möller*). The woodcut (fig. 2) shows the upper and under sides of a typical Sikkim male, but there are frequently two or three of the spots absent on the fore wing. It is quite common in Sikkim, in the low valleys during the rains. The female is a little larger, but hardly differs.

Next to those three small species we have a set of larger ones, which run very close together, but seem to be constant, and not variable in Sikkim. Of these the

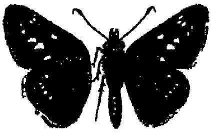

FIG. 2.—*Parnara bevani.*

first is easily recognised by its large size, and the good description and figure of both sexes.

467. *Parnara assamensis.*

Parnara assamensis, Wood-Mason & de Nicé., J. A. S. B., 1886, p. 382, t. xviii., 5, 5*a*, ♂, xvii., 7, 7*a*, ♀.

Not uncommon at 2—4000 ft., where I have found it in virgin forest, as well as in open places. It occurs in Cachar and the Khasia hills.

468. *Parnara pagana.*

Parnara pagana, de Nicé., P. Z. S., 1887, p. 465, t. xl., fig. 7, ♂.

A common species at low elevations during most of the year. Smaller than *assamensis*, and differing from that and *P. narooa* in the under side being unspotted. The female is large and more tinted with greenish fulvous above than the male. I have not seen *P. narooa* from Sikkim, but it occurs in the district of Bakarganj in Bengal, and in Bombay, Ceylon, and Cachar; so it may probably turn up in Sikkim. *P. jansoni* from Japan is very close to *narooa*, but the hind wing seems to be broader and the spots of hind wing below larger.

469. *Parnara plebeia.*

Parnara plebeia, de Nicé., P. Z. S., 1887, p. 466, t. xl., fig. 2, ♂.

This species is very close to, if not identical with, *P. kumara*, Moore, P. Z. S., 1878, p. 687, which occurs

in Canara and Ceylon. I have a female from Coonoor, in the Nilghiri hills, named by Moore, which agrees with one of my seven females of *plebeia* from Sikkim almost exactly, but differs from the other six in having a spot on the under side of the hind wing between the two lower median branches. The male as described agrees with *plebeia*, except in having this spot, which I do not find in any of my five Sikkim males. De Nicéville does not allude to this species in his description of *plebeia*, though he rightly says that it is distinct from *P. austeni*, *cahira*, and *farri*.

470. *Parnara austeni.*

Baoris austeni, Moore, P. Z. S., 1883, p. 533.

I have five males from Sikkim which agree with Moore's description, though in three of them only one instead of two discal spots appear. I give a woodcut

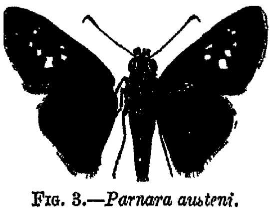

FIG. 3.—*Parnara austeni.*

(fig. 3) showing the typical insect, as no figure is published. It seems not uncommon in Sikkim, and is also found in Cachar and the Khasias.

In this group there are also described *Hesperia farri*, Moore, P. Z. S., 1878, p. 688, from Calcutta and the Khasias; and *H. cahira*, Moore, P. Z. S., 1877, p. 593, lviii., fig. 8, from the Andamans. The latter, which is not constant in the number of spots on the fore wing, is hardly, if at all distinct, from *austeni*. I have two males and two females from the Andamans, a female from Moulmein, and a pair from Tenasserim and Tavoy. The latter was identified with *P. moolata*, Moore, P. Z. S., 1878, p. 843, from Tenasserim, but as it is said by Moore to be allied to *kumara* and *cahira*, whilst no

distinctive characters are given to separate any of these forms, I am inclined to think that some of them will prove identical.

471. *Parnara tulsi.*

Parnara tulsi, de Nicé., J. A. S. B., 1883, p. 86, t. x., 1, ♂.

This species, which is rarer in Sikkim than either *austeni*, *pagana*, or *plebeia*, is very like the latter species above, but easily distinguished by the dull purplish colouring of the hind wing below.

Then we have two nearly allied but quite distinct species, both of which range through Bhotan to the Khasias on the east, *viz.* :—

472. *Parnara toona.*

Hesperia toona. Moore, P. Z. S., 1878, p. 689, ♂.
Parnara toona, Wood-Mason & de Nicé., J. A. S. B., 1886, p. 383, ♀.

Not so common as in the Khasias, but found locally up to 7000 ft. from April to November.

473. *Panara eltola.*

Pamphila eltola, Hew., Ex. Butt., iv., Hesp., t. iv., fig. 40 (1869).
Parnara eltola, Wood-Mason & de Nicé., J. A. S. B., 1886, p. 384, t. xviii., 6, 6*a*, ♂.

Common about gardens at 5000 ft. in Sikkim, and also in the low valleys and up to 7000 ft. during the whole season.

There are some other species referred to this genus by Moore and de Nicéville, which I do not know, *viz.* :—

P. ornata, Feld., W. M. & de Nicé., J. A. S. B., 1886, t. xviii., 7, 7 *a*, from Cachar and Java, which seems nearest to *assamensis*.

P. seriata, Moore, P. Z S., 1878, p. 688, from Ceylon, which probably is the same as *kumara*; and *P. cinnara*, Moore, from Formosa, which seems to have never been

fully described, and is perhaps identical with *colaca* or *beavani*.

474. *Suastus gremius.*

Hesperia gremius, Fabr., Cat. Fabr. Lep. B. M., p. 271, t. 3, 7, ♀.

H. divodasa, Moore, P. Z. S., 1865, p. 791.

Rare in Sikkim. De Nicéville has taken it in October, and I have a specimen from Möller.

475. *Suastus swerga.*

Hesperia swerga, de Nicé., J. A. S. B., 1883, p. 89, t. x., fig. 12. ♂.

Suastus mölleri, Moore, J. A. S. B., 1884, pt. 2, p. 34.

Rare in the low valleys between June and October. I cannot tell from the description what *S. Mölleri* is, as no comparison is given with any allied species; de Nicéville, however, considers it identical with *swerga*.

476. *Suastus aditus.*

? *Suastus aditus*, Moore, J. A. S. B., 1884, lv., p. 49.

This species was described from the Andamans, and has been identified by Mr. de Nicéville. My two Sikkim specimens do not, however, agree with the description exactly. It has only been found by Möller's collectors in the low valleys during the rainy season.

477. *Sarangesa dasahara.*

Nisoniades dasahara, Moore, P. Z. S., 1865, p. 787.

Not uncommon up to 3000 ft. from April to December. It seems distinct from the *S. purendra* which is found in the North-west and Bombay. I have both species from Mandi, in the outer hills of the North-west Himalaya; *S. dasahara* also extends its range to Burmah and Tenasserim.

478. *Telicota bambusæ.*

Pamphila bambusæ, Moore, P. Z. S, 1878, p. 691, t. xlv., 11, ♂, 12, ♀.

Not common in Sikkim up to about 5000 ft. from April to December.

479. *Telicota augias.*

Papilio augias, Linn., Syst. Nat., i, pt. 2, p. 794.
Telicota augias, Wood-Mason & de Nicé., J. A. S B., 1886, p 384, t. xvii., 1, ♂.

Though I have no Javan specimens of this species with which to compare mine from Sikkim, yet I have them from the Andaman Isles, Burmah, Cochin, and Bombay; and I can only say that the differences noted in Moore's description of *bambusæ* seem to me insufficient, though the two species may be distinct. In de Nicéville's list of the butterflies of Calcutta, from whence the type of *bambusæ* came, he notes it as very common at all seasons, and includes *augias* as a rare species. The insect is not rare in Sikkim up to 5000 ft. from April to December.

480. *Telicota dara.*

Hesperia dara, Koll., Hügel's Kash., p. 455 (1844).
Pamphila mæsa, Moore, P. Z. S., 1865, p. 509, t. xxx., fig. 9.
? *P. flava*, Murr., Ent. Mo. Mag, xii., p. 4 (1875).
Padraona sp., Wood-Mason & de Nicé., J. A. S. B., 1886, p. 385.

A common species up to 5000 ft. from April to December. After comparing a long series of this species, namely, twelve from the North-west Himalaya (*mæsa*, Moore); eight from Sikkim, one named *mæsa* by Moore; four from Khasias taken by myself, three from Japan, and three from China, I believe they are all the same species; and I see that in Moore's paper on Hocking's Kangra collection he has identified *mæsa* with *dara*.

481. *Telicota mæsoides.*

Pamphila mæsoides, Butl., Trans. Linn. Soc., 1877, Zool., i., p. 554.

This wide-ranging species, though very near the last, seems constantly smaller in all localities. I have it from Sikkim, Bhotan, Khasia, Burmah, the Andamans, and Philippine Isles, Java, and Ceylon.

Telicota gola.

Telicota gola, Moore, P. Z. S., 1877, p 591, t lvii., fig. 9, ♂.

I have a specimen from Buxa, Bhotan, marked *gola* by Moore, and also one from the Andamans, whence the type of *gola* came, which appear to be very close to, but distinct from, *mæsoides*, though less marked with yellow both on fore and hind wings. It will probably be found to occur in Sikkim.

482. *Pamphila ? avanti.*

Pamphila avanti, de Nicé., J. A. S. B, 1886, p. 255, t. xi, fig 10, ♂.

Of this species two males only were brought by Moller's native hunters from the interior of Sikkim, where it probably occurs at high elevations The type, which is before me, seems very nearly allied to, but quite distinct from, *Carterocephalus argyrostigma*, Evers., from the Amur, of which I have a typical specimen.

483. *Cupitha purrea.*

Pamphila purræa, Moore, P. Z. S., 1877, p. 594, t. 58, fig. 10.

Cupitha tympanifera, Moore, J. A. S. B., 1884, p. 33.

A rare species in Sikkim at low elevations. The form from Pegu, described as *tympanifera*, is, according to de Nicéville, the same; but I have not been able to compare Sikkim specimens with the type from the Andaman Islands.

484. *Thanaos stigmata.*

Thanaos stigmata, Moore, P. Z. S., 1878, p. 694; de Nicé., J. A. S. B., t. ii, fig. 2.

Though this seems one of the commonest and most wide-ranging of its family in the Himalaya, it was overlooked until very recently by collectors. In the Northwest it occurs from 2 up to 7000 ft., and, according to Mr. Doherty, varies considerably; but in Sikkim it seems to be rather an inhabitant of the lower zone, as Moller notes it up to 4000 ft. only.

Pyrgus inachus, Men., from the Amur, of which I have

only two bad specimens from Shanghai and one from Japan, is probably of this genus, and may be identical with *T. jhora*, but fresh and perfect specimens are necessary to decide this point.

485. *Thanaos kali.*

Thanaos kali, de Nicé., J. A. S. B., 1885, p. 123, t. ii., fig 3.

Rare at about 3 to 4000 ft. from April to October.

486. *Thanaos jhora.*

Thanaos jhora, de Nicé., *l. c.*, p. 122, t. ii., fig. 4, ♀.

Both these species are found in the beds of the deep valleys below Darjeeling at about 3—4000 ft., and appear not uncommon. I have also taken what I believe to be *T. jhora* at Shillong, in the Khasia hills, where it frequents damp spots near water at 4—5000 ft. The absence of the brand on the fore wing in the male distinguishes it from *T. stigmata*, to which it is otherwise very close.

487. *Cyclopides subvittatus.*

Cyclopides subvittatus, Moore, P. Z. S., 1878, p. 693.
C. subradiatus, Moore, *l. c.*, p. 692.

A common species in the Tista and Rungit valleys up to 2000 ft from April to October. I have also taken it in the Khasias at 3—4000 ft., and cannot distinguish that form which Moore names *subradiatus* from the Sikkim one. The size and the yellow mark on the fore wing above are both variable. The species also occurs in Bhotan and the Salween district.

488. *Halpe sikkima.* (Pl. XI., fig. 3, ♂).

Halpe sikkima, Moore, P. Z. S., 1882, p. 407.

This species, which I first procured from my native collectors, and which was described with the Chumbi butterflies, proves to be common at low elevations up to about 5000 ft. in Sikkim, and occurs from April to November. In one male, which I took near Mongpo, 1200 ft., on May 28th, the spot in the cell is absent, and there are three instead of two near the apex of the wing. This may be a distinct species, so I give a figure of it

(fig. 4), as well as one of a typical male. The female is unknown to me.

489. *Halpe separata.* (Pl. XI., figs. 5, ♂, 6, ♀).

Halpe separata, Moore, P. Z. S., 1882, p. 407.

This species, which came in the same collection as the last, I have found pretty common in August on Sinchul, Gumpahar, and other roads in the heavy forest at from 6 to 9000 ft. It flies during dull and wet days from June or July to the end of August. The female, which I have figured, has an additional spot near the hind margin of the fore wing not found in the male; the other spots vary in number. It is easily distinguished from other species in the genus by the pale patch on the outer half of the hind margin of fore wing below. Both this and *sikkima* are quite distinct from *H. beturia*, which I have from Tavoy and the Andamans.

490. *Halpe kumara.*

Halpe kumara, de Nicé., J. A. S. B., 1885, p. 121, t. ii., fig. 10, ♂.

A recently-discovered species, which is, I think, quite distinct from the rest, and has the under side uniform dark brown, with a greenish shade on the hind wings. It is found, according to Möller, at the same elevation and season as the last.

491. *Halpe gupta.*

Halpe gupta, de Nicé., J. A. S. B., 1886, p. 254, t. xi., fig. 1, ♂.

A rare species, which seems to be most nearly allied to *H. separata*, but easily distinguished by the double sexual mark on the fore wing of the male.

492. *Halpe cerata.* (Pl. XI., fig. 8, ♂).

Hesperia cerata, Hew., Ent. Mo. Mag., 1876, p. 152.

This is one of the commonest of the genus, and is found up to 8000 ft. from April to November. The female is rare and differs from the male.

493. *Halpe zema.* (Pl. XI., fig. 7, ♂).

Hesperia zema, Hew., Ann. Nat. Hist., xix., p. 83 (1877).

I have taken this in the Tista valley in August, and it seems to be fairly common at similar elevations and seasons as the last.

494. *Halpe dolopia.*

Hesperia dolopia, Hew., Desc. Hesp., p. 27 (1868); Ex. Butt., Hesp., t. vi., f. 60, 61.

A rare species at low levels from April to October.

495. *Taractocera mævius.*

Hesperia mævius, Fab., Ent. Syst., iii., p. 352 (1793).
Taractocera mævius, Wood-Mason & de Nicéville, J. A. S. B., 1886, p. 385, t. xvii., 8, ♂.
T. sagara, Moore, P. Z. S., 1865, p. 792.

Hitherto found in the Terai only by Möller, but will probably occur also in the outer hills.

496. *Isoteinon atkinsoni.* (Pl. XI., fig. 9, ♂).

Isoteinon atkinsoni, Moore, P. Z. S., 1878, p. 693, t. xlv., fig. 10.
I. subtestaceus, Moore, *l. c.*, p. 844.

Moore's figure of *atkinsoni* by no means corresponds to the description, and may be the under side of *Halpe ceylonica*, which is figured just above it. It may also represent the form I figure, which is rare in Sikkim, and which Möller considers to be the spring brood of *I. atkinsoni*. *I. khasiana*, Moore, of which I have seen the type in Moore's collection, appears to be the same species.

497. *Isoteinon masuriensis.*

Isoteinon masuriensis, Moore, P. Z. S., 1878, p. 693, t. xlv., fig. 8.

This species, which, according to Major Lang, is found at 7000 ft., frequenting clover in the North-west Himalaya, is found also in the interior of Sikkim at 5 to 6000 ft., but seems local, as I have never observed it, though I have collected two seasons in the months of June to

August, when it occurs. Sikkim specimens agree well with those I have from the North-west.

498. *Isoteinon satwa.*

Isoteinon satwa, de Nicé., J. A. S. B., 1883, p. 86, t. x., fig. 15, ♂.

Not uncommon at 1—3000 ft. from April to October. Easily distinguished by the colour of the under side from any other species.

499. *Isoteinon cephala.* (Pl. XI., fig. 10, ♂).

Hesperia cephala, Hew., Ent. Mo. Mag., 1876, p. 152.

Described from Darjeeling by Hewitson, and not uncommon at low elevations from April to October.

500. *Isoteinon pandita.*

Isoteinon pandita, de Nicé., J. A. S. B., 1885, p. 121, t. ii., fig. 14, ♂.

A rare species, lately discovered by Moller's collectors at 2—3000 ft.

501. *Isoteinon flavipennis.*

Isoteinon flavipennis, de Nicé., J. A. S. B., 1885, p. 122, t. ii., fig. 4, ♀.

This species, which is also found in Bhotan and the Andamans, was discovered with the last, and must be very rare in Sikkim.

502. *Isoteinon flavalum.*

Isoteinon flavalum, de Nicé., P. Z. S., 1887, p. 463, t. xl., 1, ♂.

A single specimen of this only exists in Moller's collection, which was taken in native Sikkim.

503. *Satarupa gopala.*

Satarupa gopala, Moore, P. Z. S., 1865, p. 780, t. xlii., fig. 1.

Rare in Sikkim from 1 to 3000 ft., June to October.

504. *Satarupa sambara.*

Satarupa sambara, Moore, *l. c.*, p. 781.

Commoner than the last at the same elevation, but occurs as early as April.

505. *Satarupa bhagava.*

Satarupa bhagava, Moore, *l. c.*, p. 781.

What I take to be this species is fairly common at same elevations as the last; but I am not at all sure whether it is rightly identified, as the description, when read with those of the two following species, is not all clear. I should not myself be inclined to recognise more than two species under the three names, one which I call *phisara*, with narrower yellowish bands on hind wing, and one which I call *narada*, with pure white and broader bands.

506. *Satarupa phisara.*

Satarupa phisara, Moore, J. A. S. B., 1884, pt. ii., p. 35.
S. phisara, Wood-Mason & de Nicé., J. A. S. B., 1886, p. 390, t. xvii., fig. 4, ♂.
S. bhagava?, ♀, de Nicé., J. A. S. B., 1888, p. 90, t x., fig. 14.

This small species is common in some seasons in March at low elevations. I have only taken it at Mongpo, 3500 ft., but it occurs throughout the rains.

507. *Satarupa narada.*

Satarupa narada, Moore, J. A. S. B, 1884, pt. ii., p. 35.

Also a rare species, of which I have two specimens only, taken by Möller's collectors. The abdomen is white, excepting the anal extremity, and more slender than in the other species of the genus.

508. *Tagiades atticus.*

? *Hesperia atticus*, Fabr., Ent. Syst., iii., 1, p. 339 (1793).
Pterygospidea menaka, Moore, P. Z. S., 1865, p. 778.

Common in Sikkim up to 4000 ft., and from March to December. It occurs all along the Himalayas. Some specimens from Bhotan have no black spots within the white patch on the hind wing as usual. It is a variable species, and I am unable to distinguish *menaka*.

509. *Tagiades gana.*

Not common in the hot valleys, but found from April to December.

510. *Pterygospidea syricthus.*

Pterygospidea syricthus, Feld., Reise Nov., iii., p. 530, t. 72, 22, 23 (1867).

? *Abaratha agama*, Moore MSS.

Mr. Doherty mentions this species as having been taken in Sikkim. Möller also has taken what I believe to be this species in the Terai during the rains.

511. *Antigonus sura.*

Achylodes sura, Moore, P. Z. S., 1865, p. 786.

Abaratha sura, Dist., Rhop. Mal., p. 390, t. xxxiv., fig. 16, ♂.

Not uncommon up to 3000 ft. from April to October.

512. *Antigonus vasava.*

Achylodes vasava, Moore, P. Z. S., 1865, p. 786.

Not uncommon at Darjeeling up to about 3000 ft. in April and May. A very nearly allied, if not identical, species occurs in Central China, and I have two specimens of another perhaps new species from Akyab and Tenasserim.

513. *Darpa hanria.*

Darpa hanria, Moore, P. Z. S., 1865, p. 781, t. xlii., fig. 2.

Of this very rare species I had but one specimen from Wilson's old Sikkim collection, but Möller has recently obtained others in April and May at low elevations. The genus, if distinct, appears to be monotypic and peculiar to Sikkim.

514. *Telegonus thrax.*

Papilio thrax, Linn., Syst. Nat., i., 2, p. 794 (1767); Don., Ins. Ind., t. 49, fig. 2 (1800).

Not a common species at low elevations during the rains.

515. *Telegonus thyrsis.*

Papilio thyrsis, Fabr., Syst. Ent., p. 332 (1775).
Hesperia pandia, Moore, Cat. Lep. E. I. C., p. 254, t. 7, figs. 10, 10*a* (1857).

Rarer than the last. I have never seen a specimen from Sikkim.

516. ? *Telegonus acroleuca.*

Telegonus acroleuca, Wood-Mason & de Nicé., J. A. S. B., Aug., 1881, p. 260, ♂.
Hesperia hiraca, Moore, Trans. Ent. Soc. Lond., Sept., 1881, p. 313, ♀.

A single specimen obtained by de Nicéville from a native collector.

517. *Chæticneme ? Lidderdali*, n. s.

This remarkable species is only known to me from a single specimen in the British Museum, which came out of Lidderdale's collection, and though it may possibly have come from Buxa, is more probably a Sikkim insect.

Colour olive-brown, darker towards the apex, with yellowish olive hair on thorax and hind wings. A series of irregular transparent spots near the apex of fore wing, and five larger ones in a band across it, the largest of which closes the end of the cell. On the hind wing above is a series of eight oblong black spots margined with light olive. Fringe of hind wings light olive. Beneath the markings are similar, with the addition of a black oblong spot across the end of the cell of the hind wing. Abdomen dark, with olive bands. Antennæ brown. Expanse, 2 in.

The species is placed without a name in the genus *Chæticneme* in the British Museum collection.*

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* A species which seems allied to this has recently been described from the Tippera hills by Doherty in J. A. S. B., 1886, p. 263, as *Erionota lalita*.

518. *Plastingia noemi.*

Plastingia noemi, de Nicé., J. A. S. B., 1885, p. 120, t. ii., fig. 15, ♂.

The male only of this species, which seems to resemble in form and colour the females of *P. augias*, has been discovered by Moller at low elevations, where it is found from May to August.

519. *Hyarotis adrastus.*

Hesperia adrastus, Cram , Pap. Ex., iv., t. 319, f. F, G (1780).

Plesineura praba, Moore, P. Z. S., 1865, p. 790.

Not a common species in the valleys up to 3 or 4000 ft. from April to October.

520. *Coladenia dan.*

Papilio dan, Fabr., Mant. Ins., ii., p. 88 (1787),

Hesperia fatih, Koll., Hugel's Kash., iv., p. 454, t. xviii., figs. 5, 6, ♀.

? *Plesioneura dhanada*, Moore, P. Z. S , 1865, p. 789.

I cannot separate the Sikkim race, which has been identified with *dan*, from the North-western form described by Kollar, though it is usually rather larger in Sikkim and Khasia. I have three specimens from Burmah smaller than any of the North-western specimens. It occurs not uncommonly in Sikkim up to about 4000 ft. from March to October. De Nicéville, however, thinks they are to be distinguished, and also identifies as a Sikkim species *Plesioneura dhanada*, Moore, which by the description seems to me to be the same as *C. dan.*

521. *Coladenia indrani.*

Plesioneura indrani, Moore, P. Z. S., 1865, p. 789.

Found with the last at similar elevations. It varies somewhat, but agrees with Burmese and Tenasserim specimens.

522. *Coladenia tissa.*

Coladenia tissa, Moore, Lep. Ceyl., p. 180, t. 67, fig. 6.

I have not seen this rare species, which is recorded from Sikkim; but from the plate I should have imagined that it was not separable from *indrani*. Möller has a

single male, which is paler and smaller than *indrani*, and, if distinct, may be called *C. tissa*.

523. *Coladenia pralaya.*

Pterygospidea pralaya, Moore, P. Z. S., 1865, p. 779.

Rather rare at low elevations during the rains. According to Distant, the *C. trichoneura* of Feld., from the Malay region, is distinguished by the pearly-white colour of the hind wings beneath.

524. *Udaspes folus.*

Papilio folus, Cram., Pap. Ex., i. t. 74, fig. 7 (1779).

Not so common in Sikkim as it seems to be in other parts of the Himalaya, but found up to 4 or 5000 ft. from April to October.

525. *Plesioneura alysos.*

Plesioneura alysos, Moore, P. Z S., 1865, p. 789.
P. paralysos, Wood-Mason & de Nicé., J. A. S. B., 1881, p. 257.

Common up to 4 or 5000 ft. from March to December.

526. *Plesioneura restricta.*

Plesioneura restricta, Moore, Lep. Ceyl., p. 178 (1881); Wood-Mason & de Nicé., J A. S. B , 1886, t. xvii., fig. 5, ♂.

I was long disposed to consider this a form of *alysos*, but a comparison of sixteen specimens of the former from such widely-scattered places as Kangra, Sikkim, the Andamans, Philippine Islands, and Foochow, with twenty-two of *P. restricta* from various parts of India, the Andamans, and Burmah in my collection, lead me to think that they can be certainly defined as distinct species.

527. *Plesioneura nigricans.*

Plesioneura nigricans, de Nicé., J. A. S. B., 1885, pt. ii., p. 123. t. ii., fig. 6, ♀.

A rare species, which Möller's collectors have recently

discovered. Judging from the plate, it seems allied to *leucocirca* rather than to *alysos*.

528. *Plesioneura badia.*

Pterygospidea badia, Hew., Ann. Nat. Hist., 1877, p. 322; id., Desc. Lep. Atk., p. 4 (1879); de Nicé., J. A. S. B., 1883, t x., fig. 10.

A very rare species, of which I have a single specimen only from Wilson's collection. According to Moller it occurs at low elevations.

529. *Plesioneura leucocirca.*

Hesperia leucocirca, Koll., Hugel's Kash., iv., p. 451, t. xviii., figs. 3, 4 (1844).

Plesioneura leucocirca, W. M. & de Nicé., J. A. S. B., 1881, p. 257.

? *P. munda*, Moore, J. A. S. B., 1881, p. 33.

This species occurs at low elevations up to about 4000 ft. from March to October. It varies in the number of yellow spots on the hind wing, which are sometimes entirely absent. Its range from 6000 ft. in the North-west Himalaya to Burmah and the Andaman Islands is remarkable.

530. *Plesioneura chamunda.*

Plesioneura chamunda, Moore, P. Z. S., 1865, p. 788.

Not so common, but found at similar elevations and seasons with the last. The colour of the hind wings, which are olive-green bordered with black, seem to distinguish it in a satisfactory manner. The antennæ also are never white, as in *leucocirca*, which sometimes, however, has only the club white.

531. *Plesioneura agni.*

Plesioneura agni, de Nicé., J. A. S. B., 1883, p. 87, t. x., fig. 4, ♀.

Rare at low elevations in Sikkim; differs from *P. chamunda* in having the hind wing marked with black spots above and below, and the cilia not alternately brown and white, as in that species.

532. *Plesioneura pulomaya.*

Plesioneura pulomaya, Moore, P. Z. S., 1865, p. 787.

This species is common in the zone of virgin forest from 7 to 10,000 ft., occurring, like most of the insects of that elevation, only during the rainy season. It frequents dense brushwood by the side of the paths, settling on flowers of *Rubus*, and flies, like many of the insects of the forest, on dull and even on wet days. Its flight, like that of many other Hesperids, is so extremely rapid that it is almost impossible to follow it with the eye; but, after darting round for a few minutes in circles, it generally returns to the same perch. It varies somewhat in size, but is easily disiinguished from other species of the genus. The antennæ are black, with a yellow or whitish band below the club. It occurs in the interior of Sikkim, and up to 10,000 ft. in the Simla district. Wood-Mason and de Nicéville, in their paper on the butterflies of the Andamans, formerly considered this, as well as *P. chamunda*, to be inseparable from *leucocirca*; but in Sikkim, at least, I think they are separable, and this species is restricted to the higher zone, where I never saw any of the other forms.

533. *Plesioneura sumitra.*

Plesioneura sumitra, Moore, P. Z. S., 1865, p. 787.

I was at first inclined to place this form as a variety of *leucocirca*, but now think it can be distinguished by its larger size, much larger and more numerous spots on the hind wings, and bright yellow, not greyish yellow, spotted fringes. It is more like *pulomaya* in general appearance, but differs from that species in the colour of its antennæ, and the absence of the yellow spot constantly present on the hind margin of the fore wing. It seems a rare species in Sikkim. I have only three specimens taken by myself in the forest near Rikisum, in British Bhotan, at an elevation of 5—7000 ft. in August.

534. *Astictopterus diocles.*

Nisoniades diocles, Moore, P. Z. S., 1865, p. 787.

A fairly common species up to 3000 ft. from April to November.

535. *Astictopterus Butleri.*

Astictopterus butleri, W. M. & de Nicé., J. A. S B., 1883, p. 98, t. x., fig. 3, ♂; J. A. S B., 1886, p. 380, ♂ ♀.

Rarer than *diocles*, and occurs at the same time and elevation. Though very near *olivescens*, Moore, from Burmah and Assam, it seems to differ in the under side of the hind wing sufficiently to be distinguished.

536. *Astictopterus salsala.*

Nisoniades salsala, Moore, P. Z. S., 1865, p. 786.
Astictopterus stellifer, Butl., Trans. Linn. Soc., Zool., 1877, p. 555.

Not uncommon in the low valleys from March to October. It varies a good deal in the spots of the fore wing above, which are sometimes white, sometimes rufous, and sometimes absent, as in *stellifer*, Butl. It agrees with Ceylon and Burmese specimens.

Baracus septentrionum.

Baracus septentrionum, W. M. & de Nicé., J. A. S. B., 1886, p. 379, t. xviii., figs. 4, 4 *a*, ♂.

A rare species, which has only been found in the Terai by Möller, and which I have not yet seen.

It must be remembered that many of the species of *Hesperidæ* and *Lycænidæ* mentioned in this catalogue are rare and little-known species, which cannot be classified properly until they have been examined in a more thorough manner than has been possible for me to do. As, however, Mr. de Nicéville's third volume containing the *Lycænidæ* is in the press, we may hope to have before long a better knowledge of their distribution and affinities.

Explanation of Plates VIII., IX., X., & XI.

PLATE VIII.

Fig. 1. *Lethe tristigmata*, ♂.
2. *Saturnia Royi*, ♂.
3. *Zophoessa jalaurida*, ♂.
4. *Z. molleri*, ♂.
5. *Chilades pontis*, ♂.
6. *Camena ctesia*, ♀.
7. *Sinthusa virgo*, ♀.

PLATE IX.

1. *Zophoessa dura*, ♂.
2. *Z. ramadeva*, ♂.
3. *Lethe siderea*, ♂.
4. *Athyma orientalis*, ♂.
5. *Mycalesis nicotia*, ♀.
6. *Satyrus loha*, ♂.

PLATE X.

1. *Grapta c-album* var. *tibetana*, ♂.
2. *Delias belladonna* var. *ithiela*, ♀
3. *D. belladonna* var. *horsfeldi*, ♀.
4. *Melitæa orientalis*, ♂.
5. " " ♀.

PLATE XI.

1. *Megisba malaya*, ♂.
2. *Neopithecops hamada?*, ♂.
3. *Halpe sikkima*, ♂.
4. " " var. vel sp. nov., ♂.
5. *H. separata*, ♂.
6. " " ♀.
7. *H. sema*, ♂.
8. *H. cerata*, ♂.
9. *Isoteinon atkinsoni*, ♂.
10. *I. cephala*, ♂.

XII. *List of Diurnal* Lepidoptera *collected in Northern Celebes by* Dr. Hickson. By J. O. Westwood, M.A., F.L.S., Hon. Life Pres. Ent. Soc. Lond.

[Read August 1st, 1888.]

Plate XII.

The following is a list of the butterflies collected in the islands of Northern Celebes by Dr. Sydney Hickson, now Deputy-Professor of Comparative Anatomy in the University of Oxford, during a short visit to those islands, whither he had gone with the view of studying Marine Biology, especially the various species of corals which abound there. The precise localities of the insects are carefully recorded, as well as the times of their capture, both of which circumstances are important, as the ornithological fauna of these islands offers several interesting geographical peculiarities.

PAPILIONIDÆ.	Amblypodia centaurus, var.	NYMPHALIDÆ.
Papilionides.	Polyomm. cyanescens.	Diadema Lasinassa.
Papilio Blumei.	P. Cnejus.	D. Dionea.
P. Polytes.	P. Otis.	Messaras Mæonides ?.
P. Severus.	DANAIDÆ.	M. ophthalmicus.*
P. Telephus.	Danais Ismare.	Laogona Hippocla.
P. Agamemnon.	D. Ishma.	Precis Idas, var.
Pieridæ.	D. Cleaspes.	Neptis Antara.
Catopsilia Catilla.	D. Iuoptena.	Cynthia Arsinoë.
Terias Hecabe.	D. affinis.	Adolias Nesimachus.
T. Tilaha.	D. fulgurata.	Clerome chitone.
T. Talissa.*	Euploea Kadu.	Cyllo Leda, var.
Tachyris Phestus.*	Ideopsis vitrea.	Mycalesis Janardana.
LYCÆNIDÆ.	I. Horsfeldii.	M. mutata.
Liphyra Brassolis.		Ypthima Kalelonda.*

Fam. 1. PAPILIONIDÆ.

Subfam. 1. PAPILIONIDES.

1. *Papilio Blumei*, Boisduval, Sp. G., i., p. 206 (1836).
Hab. Kalelonda, 3000 ft., April 6th, 1886.

2. *Papilio Polytes*, Linn., Mus. Ulr., p. 106 (1764); Cramer, iii., pl. 265, fig. C.

Hab. Talisse Island, Nov. 2nd, 1885.

3. *Papilio Severus*, Cramer, iii., pl 277, f. A, B (1782).

Hab. Celebes, 1886.

Var. Maculis pallidis multo minoribus.

4. *Papilio Telephus*, Wallace, Trans. Linn. Soc., xxv., tab. 7, f. 4, 1865.

Papilio Eurypylus, Linn., var.

Hab. Songer, Nov. 24th, 1885.

5. *Papilio Agamemnon*, Linn., Mus. Ulr., p. 202 (1764).

Papilio Ægistus, Cram., ii., pl. 106, f. C, D.

Hab. Great Songir.

Subfam. 2. PIERIDES.

6. *Catopsilia Catilla*, Cramer, iii., pl. 229, f. D, E (1779); Moore, Lep. Ceylon, pl. 17, f. 3 ♂, 3*a*, ♀.

Hab. Manarang, Kabroecken Island (Talauer Islands). Nov. 21st, 1885.

Obs. Males only of this species were collected. Their wings are yellow mustard-colour, the outer portion beyond the middle gradually whiter (paler) coloured, with a very slender black apical margin. The fore wings in this sex have a tuft of very fine white decumbent hairs, capable of erection on the under side near the base of the inner margin, and the hind wings are furnished near the base of the costal margin on the upper side with a small oval silky patch. The under side of the wings are entirely concolorous and destitute of any discoidal marking.

7. *Terias Hecabe*, Linn., Mus. Ulr., p. 249 (1764); Moore, Lep. Ceylon, pl. 45, f. 1.

Hab. Talisse Island, April 20th, 1886; Kalelonda, April 6th, 1886.

8. *Terias Tilaha*, Horsfield, Cat. Lep. E. Ind. Comp., p. 136 (1829); Vollenh., Mon. Pier., p. 65. (Expans. alar. antic. unc. 2⅕).

Hab. Talisse Island, Sept., 1885.

Syn. *Terias Tondana*, Felder, Novara, pl. 26, f. 1.

Var. Dimidio minor. (Exp. alar. antic. unc. 1⅘) aliter omnino congruit.

Hab. Talisse Island, Sept. 21st, 1886.

Obs. The two individuals of this species, notwithstanding their great difference in size, agree in the relative proportions of the yellow and dark colours of the wings. In both the yellow in the hind wings forms a large oval patch (more than half the size of the entire wing) occupying the whole of the costal margin, and differing from *T. Celebensis* of Wallace, Trans. Ent. Soc. Lond., ser. iii., t. 6, f. 1, in having the inner margin of the fore wings broadly black.

9. *Terias Talissa*, Westw., n. s.

Parva, alis anticis rotundatis, omnibus supra fuscescentibus, striola tenui obliqua discoidali parum curvata, nec costam nec angulum analem attingente pallide flava; alis posticis supra plaga magna costali (tertiam partem alæ occupante) pallide flava angulum externum haud attingente; alis infra pallide flavescentibus, anticis nubila obscura vix determinata subapicali, margine interno pallide nigricanti, cellula discoidali lineola tenuissima bipartita, terminata; alis posticis macula parva fusca pone medium costæ notatis. Expans. alar. anticarum unc. 1⅗.

Hab. Talisse Island, Oct. 14, 1885.

10. *Tachyris Phestus*, Westw., n. s.

Tachyris agrippinæ, Wallace & *Neroni* affinis.

Alis omnibus fuscis, fulvo variegatis; anticis apice subacuminatis; fascia dimidiata fulva e medio alæ (in cellulam haud extensa) et in medio disci posticarum continua; ibi sensim acuminata et ante angulum analem terminata; maculis quinque fulvis inter medium et apicem anticarum et quinque inter fasciam et marginem externum; alis anticis infra basi fulvis, medio irregulariter fusco-nigricanti, apice griseo-flavescenti; ad apicem posticum fulvo irregulariter maculatis, maculis versus costam magis

lutescentibus; alis posticis lutescentibus, fascia irregulari pone medium margine parum saturatiori. Exp. alar. antic. unc. 3¼.

Hab. Talisse Island, 1886.

Fam. 2. LYCÆNIDÆ.

11. *Liphyra Brassolis*, Westw., Proc. Ent. Soc. Lond., p. 31 (1864).

Sterosis robusta, Felder, Novara, p. 219 (1865), t. 27, figs. 10, 11.

Hab. Manarang, Kabroecken Island (Talauer Islands), Nov. 21st, 1885.

Obs. The unique specimen captured is much paler than my original types, or than the insect figured by Dr. Felder. It is of a rich orange-buff on the upper side of the wings, with a dark brown apical margin scarcely extending along the inner margin of the fore wings, the disc with a rather large conical blackish spot at the anterior end of the discoidal cell, and a larger oval one of the same colour divided in two by the second branch of the median vein; the hind wings with two small, oval, blackish spots on the disc just below the middle, each attended by a smaller spot on its inner edge; these spots are wanting on the under side of the hind wings.

12. *Amblypodia Centaurus*, var.?, Fabricius, Syst. Ent., p. 520 (1775).

Amblypodia Anunda?, Hew., Ill. D. Lep., t. 3*a*, fig. 32.
A. Aglais, Felder, Novara, pl. 29, f. 11.

Hab. Talisse Island, Sept. 10th, 1885.

Obs. The only specimen captured is in bad condition. It is above blackish brown, with a rich purple oval patch scarcely occupying half of the disc of the fore wings, and another of the same colour not extending beyond the basal half of the hind wings, which have the margin and anal angle much torn. On the under side the wings are paler brown, with a number of circular white lines and curved striolæ forming a series of spots more or less confluent. The anal angle marked with silvery-green scales.

13. *Polyommatus (Plebeius) cranescens*, Butler, Proc. Zool. Soc., 1875, p. 615 (♂ ♀).

Hab. Talisse Island (Oct. 19th, 1885, ♂; May 19th, 1886, ♂; Dec. 3rd, 1885, ♀).

14. *Polyommatus (Cupido) Cnejus*, Fabricius, Ent. Syst., Suppl., p. 430 (1798); H.-Schaffer, Exot. Schm., ii., f. 120.

Hab. Talisse Island (Oct. 14th, 1885; Oct. 16th, 1885). Great Senger (1886)

15. *Polyommatus (Cupido) Otis*, Fabricius, Mant Ins., ii., p. 73 (1787); Butler, Cat. Fabr., t. 2 f. 8, 11.

Hab. Talauer; Great Senger (Nov. 2nd, 1870. Manarang, Kabroecken Island (1886).

Fam. 3. DANAIDÆ.

16. *Danais Ismare*, Cram., iii., pl 279, E, F (1782); Butler, Proc. Zool. Soc. ((1866), p. 173, f. 1.

Hab. Talisse Island (Aug. 9th, 1885; Sept. 5th, 1885; Oct. 18th, 1885). Senger (Nov. 24th, 1885).

17. *Danais Ishma*, Butler, Cist. Ent., i., p. 2 (1869); Lep. Exot., i., t. 20, f. 3 (1871).

Hab. Talisse (Sept. 4th, 1885; Sept. 5th, 1885; Sept. 6th, 1885; Sept. 19th, 1885).

18. *Danais Cheaspes.*

Hab. Manarang, Talauer Islands, Nov. 21st, 1885.

19. *Danais (Radadeba) luciplena*, Butler.

Hab. Talisse, July 9th, 1885; Kalolonda, April 14th, 1886.

20. *Danais affinis* (*plexippus*, Linn., var. ?), Fabricius, Syst. Ent., p. 511 (1775); Donovan, Ins. Ind., t. 25, f. 2 (1800).

Obs. D. Loti Cramer similis sed maculis discoidalibus albis alarum multo majoribus.

Hab. Cockatoo Island, Celebes; Talauer Islands; Nov. 17th, 1885.

21. *Danais fulgurata*, Butler, Proc. Zool. Soc., 1866, t. 4, f. 1

Præcedenti similis sed disci medio alarum rufo, macula una oblonga alba inter cellulam et medium marginis interni alarum.

Hab. Songor, Nov. 21th, 1885.

22 *Euplæa (Salpinx) Kadu*, Eschscholtz, Reise, iii., p 210, t 6, f 15, *a*, *b* (1821).

Euplæa Hewitsonii, Butler MSS

Var. Maculis subapicalibus alarum anticarum, cum maculis tribus parvis pone medium costæ, albis nec cærulescenti tinctis.

Hab. Senger, Nov. 21th, 1885.

23. *Ideopsis vitrea*, Blanchard, Voy. Pol Sud., p 385, t 2, f. 2 (1853).

Dan. Enopia, Felder, Wien. Ent M., iii , p. 182, pl. 1, f. 2 (1859).

Hab. Kalolonda, April 6th, 1886.

24. *Ideopsis Hewitsonii*, Kirsch.

Præcedenti minor, alis anticis angustioribus absque colore flavo inter medium et apicem. An præc. varietas? Expans. alar. ant. unc. 3½.

Hab. Talisse Island, April 24th, 1886

Fam. 4. NYMPHALIDÆ.

25. *Diadema Lasinassa*.

♂, Cramer, Pap. Ex., iii.,t. 205, A, B (1782).

Papilio Bolina, Linn , Mus. Ulr , p. 295.

Hab. Talisse Island, Oct 10th, 1885.

♀, *P. Nerina*, Fab., Syst Ent., 509; Don., Ins. N. Holl , t 27, f. 1.

Hab. Talisse Island, Oct. 27th, 1885; Dec. 13th, 1885.

26. *Diadema Dionea*, Hewitson, Proc Zool. Soc., 1861, t. 8, f. 2.

Hab. Kalelonda, April 14th, 1886.

27. *Messaras Mæonides ?*, Hewitson, Exot. Butt. (Moss., t. i., f. 1, 2 (1859).

Fore wings with basal half fulvous-brown, a broad oblique whitish-buff fascia extending from the middle of the costa (beyond the cell) nearly to the anal angle, where it ends in a round black spot; apex of wings dark brown, with a small obscure paler spot towards the apical angle; hind wings with the basal half reddish brown, apical portion redder brown, with a row of six black dots and two rows of submarginal black scallops. Expans. alar. antic. unc. $2\frac{1}{4}$—$2\frac{3}{4}$.

Hab. Cockatoo Island, 1886.

28. *Messaras ophthalmicus*, Westw., n. s.

Alis supra saturate fulvis, anticis costa apiceque late fuscis colore fusco ad angulum analem sensim angustato et macula obscura rotundata notatis; alis posticis concoloribus, rudimentis ocellorum paginæ inferæ vix distinctis lineaque tenui nigricanti, margine apicali parallela in omnibus alis; subtus fulvo-albidis, singula ala ocellis duobus rotundis magnis nigris puncto minuto modio notatis, circulo externo fulvo-fuscescente, arcu brunneo-fulvo inter ocellos et medium alæ, striga angulata subapicali lineaque marginali nigra; ocelloque minuto præcedenti ad angulum analem posticarum adjecto. Expans. alar. unc. $2\frac{1}{2}$.

Hab. Talisse Island, Sept. 21st, 1885.

29. *Laogona Hippocla*, Cram., iii., t 220, f. C, D.

Var. *Laogona Hylæus*, Wallace, Trans. Ent. Soc. Lond., 1869, p. 345.

Hab. Kalelonda, April 20th, 1886.

30. *Precis Ida*, var. *Iphata*, Cramer, iii., t. 209. f. C, D.

Hab. Kalelonda (April 20th, 1886), Songor (Nov. 24th, 1885), Talisse (Sept. 5th, 1885).

31. *Neptis Antara*, Moore, Proc. Zool. Soc., 1858, t. 49, f. 2.

Hab. Talisse Island, Sept. 6th, 1885; Sept. 9th, 1885; Sept. 12th, 1885.

Obs. The type-specimen of this species in the British Museum is a male measuring nearly 2 in. in expanse,

The specimens collected by Mr. Hickson are larger ($2\frac{3}{4}$ in.), and with richer and somewhat more varied orange-red markings. The tripartite spot between the middle and apex of the fore wings is larger, and followed by a curved orange-red streak and a narrower subapical one. The larger spot between the middle of these wings and the posterior angle is followed by another curved narrow one, which ascends to the third branch of the median vein, and is followed next the anal angle by a still more slender curved streak. The two orange-red bands of the hind wings are of nearly equal width, and between them and also outside of the second is a narrow obscurely paler brown striga.

32. *Cynthia arsinoë*, Cramer, Pap. Exot., t. 160, B, C (1779).

Hab. Kalclonda (April 20th, 1886), Talisse (April 20th, 1886).

33. *Adolias Nesimachus*, Boisduval, Cuv. R. An. Ins., t. 139 *bis*, f. 1 (1836).

Argynnis Hippomenes, H.-Schaff., Exot. Schm., t. 11, 12 (1850).

Hab. Kalolonda, April 14th, 1886.

34. *Clerome Chitone*, Hewitson, Exot. Butt., Pl. *Clerome*, figs. 2, 3 (1863).

Hab. Kalelonda, April 20th, 1886.

35. *Cyllo Leda*, Linn., Syst. Nat., i., 2, 773 (1769).

Var. Pallide fusca, apice alarum anticarum albido fusco, macula ovali subapicali nigra albo-bipunctata, posticis macula parva nigra, medio puncto albo notatis.

Hab. Kalolonda, April 26th, 1886.

36. *Mycalesis Janardana*, Moore, Cat. Lep. E. Ind., t. i., p. 234 (1857).

Hab. Senger, Nov. 24th, 1886.

37. *Mycalesis mutata*, Butler, Proc Z. Soc., 1875, p. 612.
Hab. Manaranga.

38. *Ypthima Kalelonda*, Westw., n. s.

Alis supra fuscis, pone medium paullo pallidioribus, anticis ocello nigro vix distincto ante apicem, posticis etiam unico versus angulum analem; subtus anticis pallide fuscis nigro transversim striolatis, ocello unico subapicali nigro circulo fulvo cincto, posticis fuscis pone medium albis, similiter striolatis, ocellis tribus, uno minori versus angulum externum, altero majori rotundato nigro circulo fulvo cincto versus angulum analem, tertioque minuto in ipso angulo anali. Exp. alar. antic. circ. unc. 2.

Hab. Kalelonda, April 6th, 1886.

Explanation of Plate XII.

FIG. 1. *Terias Talissa*, Westw.; upper side. 2 *a*, under side.
2. *Tachyris Phestus*, Westw.; upper and under sides. 2 *a*, veins of fore wings.
3. *Messaras ophthalmicus*, Westw.; upper and under sides. 3 *a*, veins of fore wings.
4. *Ypthima Kalelonda*, Westw.; upper side. 4 *a*, under side.

XIII. *An enumeration of the* Rhynchota *received from Baron von Muller, and collected by Mr. Sayer in New Guinea during Mr. Cuthbertson's Expedition.* By W. L. Distant, F.E.S.

[Read October 3rd, 1888.]

Plate XIII.

The Rhynchota collected by Mr. Sayer, though few in number, are of great interest, and add considerably to our knowledge of that portion of the entomological fauna of New Guinea in which they were collected. The largest number of species from the island, of which we have record, were described by Mr. Walker, collected by Mr. Wallace, and are now contained in the British Museum. The late Dr. Stål has also contributed some scattered descriptions, and Dr. Signoret more recently gave a short descriptive paper of New Guinea Heteroptera belonging to the collection in the Genoa Museum. Consequently, even with the additions made by this paper, our knowledge is still very limited as to the Rhynchotal element in this entomological fauna.

In the Heteroptera of this collection are 39 species; of these I have identified 37 species, 13 being hitherto undescribed and embracing 5 new genera. The Homoptera comprise 9 species; of these 8 are identified, 4 being hitherto undescribed, including one new genus. Other species in both groups were represented by larval forms only, and it would be presumption to attempt their identification.

In this collection the Australian element or affinity is exceedingly slight, a considerable relationship exists with the fauna of the adjacent islands, and a few species are probably peculiar to New Guinea; but our present knowledge is so very limited, and the available collections so very small, that it is futile to hazard any dogmas as to geographical distribution.

RHYNCHOTA HETEROPTERA.

PENTATOMIDÆ.

PLATASPINÆ.

Coptosoma ramosa.

Coptosoma ramosa, Walk., Cat. Het., 1, p. 93 (1867).

This species was originally described from Wagiou.

SCUTELLERINÆ.

Cantao ocellatus.

Cimex ocellatus, Thunb., N. ins. Sp., 3, p. 60, f. 72 (1784).

The specimen here enumerated is an example of the variety in which the pronotal angles are not produced, or, in other words, not spined. This, however, is no local peculiarity, as I possess specimens from the Himalayas and the Malay Peninsula in which precisely the same character is found.

The species has a wide range, its area extending from Continental India to New Guinea

Philia aureocincta.

Callidea aureocincta, Walk., Cat. Het., 1, p. 41 (1867).

This species was originally described from New Guinea. I possess examples from Duke of York Island.

SCUTELLERINÆ,

Asopus micans, n. s. (Pl. XIII., fig. 6).

Above ochraceous; a large lunate spot at base of pronotum, a similar spot reversed at base of scutellum, and two small spots near apex of scutellum, dark shining blue; membrane bluish black, the margins fuscous. Legs bluish black, the coxæ, trochanters, and apices of the femora beneath ochraceous. Body beneath ochraceous. Antennæ blackish, second joint longer than the third, which is again slightly shorter than the fourth. The rostrum is ochraceous, and just passes the posterior coxæ. The scutellum and pronotum are somewhat coarsely punctate, the corium and head more finely punctate. Long. 12 mm.

PENTATOMINÆ.

Allocotus sayeri, n. s. (Pl. XIII., fig. 1).

Head, pronotum, and scutellum black; apices of spines at base of antennæ, a spine at about middle of each lateral margin of pronotum, two transverse discal central spots to pronotum, a rounded spot at each basal angle of scutellum, and the apex of scutellum, bright shining luteous. Corium brownish ochraceous, the margin pale luteous, and with a subcostal fuscous streak. Membrane dark fuscous. Head and body beneath dark bluish black, disk of abdomen luteous, legs ochraceous, apices of the intermediate and posterior femora blackish. The antennæ are fuscous-brown, the second joint longest, the third and fourth subequal in length; the eyes are strongly exserted, a strong spine at inner margin of antenniferous tubercles, another long spine at middle of each lateral margin of pronotum, the lateral pronotal angles are produced into long, convex, recurved spines. Long. 7 mm.

The structure of the pronotal spines, in addition to the differences of coloration, will at once distinguish this species from the Australian *A. Rogenhoferi*, Mayr, and the New Guinea *A. Mayrii*, Sign.

Spudæus parvulus.

Halys parvula, Hope, Cat., 1, p. 22 (1837).

This species has been recorded from Northern Australia. I possess specimens from Port Moresby.

ECDICIUS, n. g.

Head with the central lobe about as long as the lateral lobes, which are somewhat obtusely angulated at apex, giving the anterior margin of the head an emarginate appearance; eyes inserted near base; antenniferous tubercles spinous externally; basal joint of antennæ extending beyond apex of head (number of joints unknown owing to mutilated condition). Pronotum longer than head, posterior lateral angles slightly prominent and subacute, and with an obtuse tooth at anterior lateral angles. Scutellum subtriangular, its apex reaching interior angle of corium; lateral margins of corium somewhat ampliated and covering connexivum; membrane with the venation reticulated. Rostrum reaching the posterior coxæ, second joint a little longer than third, but much shorter than third and fourth together. Abdomen not perceptibly furrowed. Mesosternum with a central longitudinal ridge.

I place this genus near *Pœcilotoma*, Dall.

Ecdicius typicus, n. s. (Pl. XIII., fig. 3).

Obscure ochraceous, thickly covered with dark, coarse, fuscous punctures. Head with the ocelli red, the eyes dark fuscous; antennæ ochraceous, third joint fuscous towards apex (remainder mutilated). Pronotum with the anterior half of lateral margins, and the posterior margin of lateral angles, narrowly ochraceous. Anterior portion of lateral margins of corium and apex of scutellum narrowly ochraceous; corium with the disk darker in places by confluent punctures and fuscous shadings. Membrane pale fuscous, inner two-thirds much suffused with pitchy-black, the outer margin spotted and marked with fuscous, the venation reticulated at inner basal area. Body beneath brownish ochraceous, much suffused with pitchy-black on sternum, base and near apex of abdomen, remaining surface darkly punctate, with a marginal segmental series of small black spots. Legs ochraceous, femora and bases of tibiæ more or less spotted with black, apices of tibiæ and the tarsi (excepting the bases of joints) fuscous-black. Rostrum (excluding basal joint) more or less fuscous. Antennæ with the second and third joints subequal in length, the remainder mutilated. Long. 11 mm.; exp. pronot. angl. 6 mm.

ACCARANA, n. g.

Allied to *Eclenus*, Dall., but having the head less elongated, the central lobe only very slightly projecting in front of the lateral lobes. Antennæ five-jointed, slender, inserted a little in front of the eyes, the antenniferous tubercles prominent and obtusely subspinous; the basal joint distinctly passing the apex of the head. Eyes prominent and globose. Rostrum not extending much beyond the posterior coxæ, with the second joint not equalling in length the third and fourth joints combined. Pronotum with the lateral angles strongly produced into moderately stout spines, the lateral margins concave, the anterior lateral margins obscurely crenulate. Ventral furrow short, not extending beyond the second abdominal segment; other characters generally as in *Eclenus*.

Accarana metallica, n. s. (Pl. XIII., fig. 4).

Ochraceous, thickly covered with coarse bronzy-green punctures. Head with the basal margin and the posterior lateral margins of central lobe purplish red; eyes purplish red, the margins ochraceous; antennæ fuscous, the basal joint more or less ochraceous. Pronotum with the anterior and posterior margins very narrowly ochraceous, the produced pronotal angles purplish red. Scutellum

with the apex ochraceous and very sparingly punctate, a small foveate dark metallic-green spot at each basal angle. Corium tinged with purplish, except at costal area. Membrane shining fuscous, the veins, base, and lateral margins bluish black, the apex pale fuscous. Connexivum ochraceous, with a few dark punctures, the segmental angles narrowly dark bluish black. Body beneath and legs ochraceous; legs spotted with black, a submarginal fascia to prosternum and abdomen metallic-green, surrounded with purplish punctures, a broad submarginal fascia to meso- and metasterna purplish. Antennæ with the fourth and fifth joints longest and subequal in length, second and third joints subequal or third joint a little longer than second, third, fourth, and fifth joints pilose. The pronotal angles subacute and directed outwardly. The membranal veins are longitudinal, and not reticulated. The rostrum is ochraceous, streaked with fuscous above, and just passes the posterior coxæ. The anterior femora are obscurely spined beneath towards apex. Long. 15 mm.; exp. pronot. angl. 9 mm.

Agonoscelis rutila.

Cimex rutilus, Fabr., S. Ent., p. 714, 88 (1775).

Somewhat generally distributed throughout the Malay Archipelago, and found in Australia. I possess specimens from Port Moresby and Duke of York Island.

NOVATILLA, n. g.

Head large, broad, about as long as pronotum, lateral margins moderately and concavely sinuate, central lobe very slightly projecting in front of lateral lobes. Antennæ five-jointed, eyes somewhat exserted. Pronotum twice as broad as long, lateral margins slightly sinuate. Scutellum subtriangular, shorter than corium, narrowed beyond middle, the apex rounded and extending a little beyond the base of membrane. Corium outwardly and moderately convexly laminate, and coarsely punctate. Connexivum projecting beyond middle of corium. Rostrum passing the posterior coxæ. Abdomen somewhat obscurely sulcated near base. Tibiæ sulcated.

I place this genus near *Afrunia*, from which the sulcated tibiæ will alone at once distinguish it. It also includes the *Pentatoma virgata*, Dall.

Novatilla fasciata, n. s. (Pl. XIII., fig. 2).

Head reddish ochraceous, margins of the central lobe and eyes somewhat blackish; *antennæ black, with the basal joint ochraceous*. Pronotum olivaceous, tinged with reddish anteriorly, the anterior and lateral margins luteous, and crossed by six broad black fasciæ, of which the second on each side is shortest and slightly curved. Scutellum pale olivaceous, with two broad longitudinal black fasciæ, and with a small black punctate spot at each basal angle. Corium reddish ochraceous, with a broad irregular black fascia. Membrane black, with the apical margin pale fuscous. Body beneath reddish ochraceous or pale violaceous, lateral margins of sternum and abdomen broadly black, and a broad central fascia to abdomen (sometimes not reaching base) also black. Legs bright olivaceous, the tarsi infuscated. Antennæ with the fourth joint longest, second slightly shorter than third. Head obscurely transversely striate. Pronotum, scutellum, and corium coarsely punctate, apex of scutellum almost impunctate. Long. 8 mm.

This species is allied to the Australian *N. virgata*, Dall., from which it not only differs by the more fasciate markings, but also by the structure of the antennæ, which in *N. virgata* have the second and third joints subequal in length.

Plautia affinis.

Plautia affinis, Dall., List. Hem., 1, p. 252, 50 (1851).

Originally described from Australia; also found in Duke of York Island.

Cuspicona [2] *ampla.*

Cuspicona ampla, Walk., Cat. Het., 2, p. 381, 9 (1867).

Originally described from Wagiou.

TESSARATOMINÆ.

Agapophyta bipunctata.

Agapophyta bipunctata, Boisd., Voy. de l'Astrol., Ent., ii., p. 626, t. ii., f. 5 (1835).

A somewhat local species.

DINIDORINÆ.

Megymenum papuensis, n. s.

Allied to *M. subpurpurascens*, Westw., but differing by the

truncate, and not concave outer margin of the lateral pronotal angles, and by the lateral lobes of the head being not distinctly cleft anteriorly. Long. 12 to 13 mm.

COREIDÆ.

COREINÆ.

Div. Mictaria.

Mycillus, n. g.

Head emarginate between the antenniferous tubercles. Antennæ with the basal joint about equal in length to the fourth joint, which is longer than the third. Pronotum with the lateral angles moderately produced, the lateral margins obscurely crenulated. Rostrum with the fourth joint about equal in length to the second joint, third joint shortest. Abdomen beneath (in the male) with the first and second segments elevated, and centrally somewhat produced posteriorly, prolongation of first segment emarginate, that of second segment convex, second segment with a somewhat acute and robust tubercle on each side, third segment with a small tubercle on each lateral margin. Posterior femora (in male) robust, curved, obscurely spined beneath, more prominently so at apex; posterior tibiæ flattened and dilated on each side, outwardly convex for nearly the entire length, and terminating in a short recurved spine at apex, inwardly dilated for nearly half its length, with its inner margin crenulate.

This genus is allied to *Plectrocnemia* and *Pternistria*.

Mycillus explicatus, n. s. (Pl. XIII., fig. 11).

♂. Dark fuscous, finely and more palely pilose. Antennæ with the apical joint greyish brown and thickly pilose; apex of the scutellum ochraceous. Antennæ with the first, second, and fourth joints subequal in length, the third joint shortest; lateral angles of the pronotum moderately and subacutely produced; rostrum reaching the intermediate coxæ. Long. 20 mm.; exp. pronot. angl. 7½ mm.

Div. Cloresmaria.

Prionemicoris flaviceps.

Nematopus flaviceps, Guér., Voy. Coq. Ins., p. 177, Atl., t. 12, f. 10 (1830).

Apparently confined to New Guinea and the adjacent islands.

Div. Gonocleraria.

Cletomorpha alternata.

Gonocerus alternatus, Dall., List. Hem., 2, p. 195, 6 (1852).

Originally described from Java, but a New Guinea specimen is also contained in the British Museum collection.

Div. Leptocorisaria.

Leptocorisa acuta.

Cimex acutus, Thunb., N. ins. Sp., 2, p. 34 (1783).

A very widely-distributed species, recorded from China, Philippine Islands, Java, and Australia, but not previously from New Guinea.

Div. Alydaria.

Riptortus linearis.

Cimex linearis, Fabr., Syst. Ent., p. 710, 62 (1775).

A very widely-distributed species, already recorded generally from Continental India to New Guinea.

Div. Serinetharia.

Serinetha fascicollis.

Serinetha fascicollis, Walk., Cat. Het., iv., p. 148 (1871).

The typical specimens are from the island of Mysol.

LYGÆIDÆ.

LYGÆINÆ.

Astacops plagiatus.

Astacops plagiatus, Stal, Ann. Soc. Ent. Fr., ser. 4, vol. 5, p. 186, 1 (1865).

Described from specimens received from the island of Mysol.

Astacops australis.

Astacops australis, Boisd., Voy. Astr. Ent., 2, p. 637, t. 11, f. 15 (1835).

This species is already recorded from New Guinea.

MONTALTUS, n. g.

Metasternum behind obliquely truncated. Eyes prominent, but not stylated; ocelli about the same distance apart as from eyes; head grooved on each side before eyes; basal joint of the posterior coxæ longer than the second and third joints together. Scutellum with an apical raised central carina. Rostrum with the third and fourth joints subequal in length. Femora unarmed.

I place this genus near *Graptostethus*, Stål.

Montaltus tricolor, n. s. (Pl. XIII., fig. 9).

Head, antennæ, anterior third of pronotum, legs, and abdomen, red: posterior two-thirds of pronotum, scutellum, apex of corium, and base of membrane, black; eyes, and corium excluding apex, luteous; sternum dark violaceous. Antennæ with the first joint short, the second and fourth joints subequal in length and a little longer than the third joint, the fourth joint palely pilose; head and pronotum finely and sparingly pilose. Long. 10 mm.

PYRRHOCORIDÆ.

PYRRHOCORINÆ.

Ectatops ruficosta.

Ectatops ruficosta, Walk., Cat. Het., vi., p. 27 (1873).

Originally described from New Guinea.

The specimens collected by Mr. Sayer have the pale markings yellow and not red, as in the typical specimen described by Walker.

Dindymus varius.

Dindymus varius, Walk., Cat. Het., vi., p. 9 (1873).

In the British Museum collection are specimens from Aru, Kó, and New Guinea; I also possess specimens from the Duke of York Islands.

In the specimen collected by Mr. Sayer, as well as in those from the Duke of York Islands, the pale coloration is yellow and not red, as in those described by Walker.

Dindymus nigellus, n. s.

Head above and beneath, antennæ, pronotum, scutellum, base of corium to about apex of scutellum, rostrum, sternum, legs, and

central base of abdomen, bluish black; abdomen, corium, membrane, and basal half of apical joint of antennæ, ochraceous; tibiæ and tarsi somewhat brownish. Pronotum behind the anterior transverse impression and the corium somewhat coarsely punctate; scutellum somewhat gibbous at base; anterior femora spined beneath near apex; antennæ with the basal joint longest, second and fourth joints subequal in length, and a little longer than the third joint. Long. 12 mm.

This species is placed near *D. albicornis*, Fabr.

Dysdercus cingulatus.

Cimex cingulatus, Fabr., Syst. Ent., p. 719, 108 (1775).

A very widely-distributed species, found in Continental India and China, and distributed throughout the whole length and breadth of the Malayan Archipelago.

Dysdercus papuensis, n. s.

Body above black; anterior area of pronotum reddish ochraceous; margins of pronotum and costal, claval, and apical margins of corium ochraceous, posterior margins of membrane narrowly greyish. Body beneath reddish ochraceous; head, legs, a large spot on meso- and metasterna, and disk of basal segments of abdomen, black; anterior and posterior margins of prosternum, posterior margins of meso- and metasterna, outer margins of coxæ, and posterior margins of abdominal segments, pale shining ochraceous-white; outer margins of sternum and corium beneath ochraceous. Rostrum reddish ochraceous, basal joint and apex black, the last extending to the second abdominal segment. Antennæ with the first and fourth joints subequal in length, apex of the first joint slightly incrassated, second and third joints shortest, second longer than third. Long. 16 mm.

Allied to *D. philippinus*, H.-S., and *D. decussatus*, Boisd. I possess a specimen of this species from Murray Island.

Dysdercus mesiostigma, n. s. (Pl. XIII., fig. 12).

Dysdercus mesiostigma, Walk. (MS.).

Reddish ochraceous; antennæ, eyes, basal margin of scutellum, a spot at basal angle of membrane, rostrum (excluding base), tibiæ, tarsi, anterior margin of mesosternum, and a lateral series of ventral spots, black or blackish. Membrane brownish ochraceous

Antennæ very narrowly reddish at base, first, second, and fourth joints subequal in length, third joint shortest, rostrum long, reaching the penultimate segment of the abdomen.

Var. *a*. Abdomen beneath without the blackish lateral series of spots. Long. 20 to 22 mm.

This species is arranged in the British Museum collection under the above apparently manuscript name.

Dysdercus simplex, n. s.

Head red; eyes, antennæ, and a basal spot behind each eye, black. Pronotum ochraceous, a transverse spot before anterior margin red, narrowly bordered with fuscous, the posterior disk sparsely punctured with fuscous. Scutellum black, the apex triangularly reddish ochraceous. Corium pale fuscous, the costal margin broadly ochraceous, the claval and inner margins very narrowly ochraceous. Membrane dark fuscous. Body beneath castaneous, margins of prosternum, posterior margins of meso- and metasterna, and posterior margins of abdominal segments, very pale luteous. Legs and rostrum blackish. Antennæ with the first and fourth joints longest and subequal in length, second longer than third, which is very short. Rostrum passing the posterior coxæ. Long. 12 mm.

REDUVIIDÆ.

REDUVIINÆ.

Helonotus exsugiens.

Helonotus exsugiens, Stål, Ann. Soc. Ent. Fr., ser. 4, vol. 3, p. 29, 2 (1863).

Previously recorded from New Guinea and the neighbouring islands.

Paloptus bicolor, n. s. (Pl. XIII., fig. 10).

Shining blackish; posterior lobe of the pronotum and the corium brownish ochraceous. The head, rostrum, anterior lobe of pronotum, and legs are somewhat very dark castaneous, the scutellum and abdomen more bluish black. The lateral margins of the anterior lobe of the pronotum are unarmed; the posterior lobe possesses two discal, long, suberect spines, the lateral angles are also strongly spinous, all the spines subacute, slightly recurved, and blackish in hue. The abdomen on each side is angularly ampliated. Long. 13 to 14 mm.

Allied to *P. longispinus*, Stål.

Paloptus nigriscutis.

Paloptus nigriscutis, Stal, Stett. Ent. Zeit., pl. 22, p. 133, 1 (1861).

Hitherto recorded from New Guinea and its adjacent islands.

ACANTHASPIDINÆ.

Durganda nigripes.

Durganda nigripes, Sign., Ann. Mus. Genov., xv., p. 543 (1880).

Described from New Guinea.

Velitra interruptus.

Pirates interruptus, Walk., Cat. Het., vii., p. 124 (1873).

Described from New Guinea.

STENOPODINÆ.

Oncocephalus annulipes.

Oncocephalus annulipes, Stal, Ofv. Vet. Ak. Förh., 1855, p. 44, 1.

A very widely-distributed species, already recorded from Southern and Tropical Africa, China, Philippine Islands, Australia, and New Caledonia, and the limits of its range of distribution still undetermined.

PELOGONIDÆ.

Peltopterus sp. ?

One specimen, which may probably prove to be the *P. macrothorax*, Montr., described from the island of Woodlark.

NOTONECTIDÆ.

Enithares sp. ?

One specimen only, rendering determination doubtful.

RHYNCHOTA HOMOPTERA.

CICADIDÆ.

Bœturia exhausta.

Cicada exhausta, Guér., Voy. Coq. Ins., t. 10, f. 6.

Appears to be somewhat generally distributed in the eastern area of the Malayan Archipelago.

Bœturia beccarii.

Bœturia beccarii, Dist., Ann. Mus. Civ. Genov., ser. 2*a*, vol. vi., p. 524 (1888).

I originally described this species from a specimen collected by Dr. Beccari on Mt. Singalang in Sumatra.

FULGORIDÆ.

FULGORINÆ.

MYRILLA, n. g.

Allied to *Polydictya* in having the whole venation of the tegmina reticulated. The face possesses three longitudinal carinæ, the central one extending across its whole length, the other two somewhat oblique and not reaching apex, which is not broader than the clypeus. Tegmina four times longer than broad, much longer than wings. Rostrum long, about reaching the penultimate segment of abdomen.

Myrilla obscura, n. s. (Pl. XIII., fig. 8).

Head and thorax above ochraceous or olivaceous, more or less spotted and marked with black, abdomen above with rather more than basal half black, remainder pale olivaceous. Head and thorax beneath black, spotted with ochraceous; legs black, femora with a subapical, and anterior and intermediate tibiæ with two ochraceous annulations, posterior tibiæ almost wholly dark ochraceous; abdomen beneath blackish. Tegmina with more than basal half fuscous, the reticulated venation ochraceous, apical area pale hyaline, with irregular black markings, a few linear black spots on costal margin. Wings with basal two-thirds black, apical area pale hyaline, extreme base tinged with carmine. Long. excl. tegm. 17 mm.; exp. tegm. 48 mm.

Desudaba scylla, n. s. (Pl. XIII., fig. 5).

Head and thorax above olivaceous, eyes fuscous, abdomen above blackish, shaded with bright green at base and apex; body beneath and legs more or less olivaceous brown. Tegmina with more than basal half reddish brown, with some small scattered irregular paler spots, with a small black spot near base, and the apical area darker, with two rather prominent black spots. Wings with a little less than basal half blackish, with a central bright greenish patch, remaining area pale hyaline, the venation and extreme apex pale fuscous. Long. excl. tegm. 18 mm.; exp. tegm. 36 mm.

DICTYOPHARINÆ.

Acarna tessellata, n. s. (Pl. XIII., fig. 7).

Black; abdomen sanguineous, with its apex black, sternum and coxæ ochraceous; tegmina pale brownish ochraceous, the venation spotted with blackish, and with a subquadrate black spot a little before middle of inner margin, a smaller spot on disk, the apical third mostly blackish, with ochraceous markings.

This species has the head non-protuberant, or only moderately prominent beyond the eyes, thus easily distinguishing it from *A. rostrifera*, Stål (a species described from Mysol), but to which it is somewhat allied in the pattern and coloration of the tegmina. Long. excl. tegm. 11 mm.; exp. tegm. 24 mm.

CERCOPIDÆ.

Cosmoscarta basistriga (var.).

Cercopis basistriga, Walk., Journ. Linn. Soc., vol. x., p. 280, n. 302 (1867).

Originally described from Mysol.

JASSIDÆ.

Tettigonia sayeri, n. s.

Tettigonia maculicollis, Walk., Journ. Linn. Soc., vol. x., p. 302, n. 362 (1867).

Dr. Signoret, in 1853, having used the specific name of *maculicollis* for a Central America species of *Tettigonia*, Walker's name cannot stand, and I therefore propose that of *T. sayeri* for the New Guinea species.

Bythoscopus ? sp.

MEMBRACIDÆ.

Centrotus ? alticeps.

Centrotus alticeps, Walk., Journ. Linn. Soc., vol. x., p. 183, n. 257 (1867).

Originally described as from the island of Aru.

Explanation of Plate XIII.

FIG. 1. *Allocotus sayeri.*
2. *Novatilla fasciata.*
3. *Ecdicius typicus.*
4. *Accarana metallica.*
5. *Desudaba scylla.*
6. *Asopus micans.*
7. *Acarna tessellata.*
8. *Myrilla obscura.*
9. *Montaltus tricolor.*
10. *Paloptus bicolor.*
11. *Mycillus explicatus.*
12. *Dysdercus mesiostigma.*

XIV. *On some new Longicorn Coleoptera.* By FRANCIS P. PASCOE, F.L.S., &c.

[Read November 7th, 1888.]

PLATE XIV.

CERAMBYCIDÆ.

Neocerambyx sordidus.
Zamium crocatum.
Xystrocera promecoides.
Bethelium puncticolle.
Zathecus Batesii.
Cerosium lineigerum.
Pempsamacra argentata.
" condita.
Mecaspis simulatrix.
" dives.
Promeces auratus.
" longicollis.
" austerus.
Eroschema affine.
Icariotis, n. g.
" unicolor.
" fulvicornis.
" scapularis.
Eccrisis, n. g.
" abdominalis.
Apheledes, n. g.
" velutinus.
Antigenes, n. g.
" funebris.

LAMIIDÆ.

Psaromaia Renei.
Eryalus, n. g.
" polyspilus.
Grynex, n. g.
" lineatus.
Grammœchus ligatus.
Ecyroschema rugata.
Atybe nigritarsis.
Ropica cylindrica.
Amblesthis geminus.
Sophronica reducta.
" amplipennis.
" oblonga.
Corus, n. g.
" annulicornis.
Pachypeza marginata.
" teres.
Sparna macilenta.
Chrysaperda collaris.
Glenea Celia.
Volumnia morosa.
Ochræsius, n. g.
" stictiens.
Orica, n. g.*

PRIONIDÆ.

Syennesis, n. g.
" dispar.

* For Zygocera ? albo-virgata, *Fairm.*

Neocerambyx sordidus.

N. piceo-fuscus, pube brevi grisea omnino tectus; prothorace valido, interrupte plicato; elytris paulo planatis, haud ampliatis. Long. 13 li[illegible]

H[illegible] Laos.

Pitchy brown, everywhere covered with a short greyish pubescence; scape of the antennæ short, stout; prothorax broadly transverse, roughly rounded at the sides, anterior border smooth, the rest interruptedly plicate; scutellum transversely triangular;

elytra subparallel, flattish, not broader than the middle of the prothorax, posteriorly bordering the suture areolate; prosternum raised, truncate, and pointed behind.

This species has the facies and peculiar pubescence of *Taurotagus Klugii*, but the characters are more in accord with *Neocerambyx*. The whole subfamily are, as Lacordaire observes, "rebels to classification."

Zamium crocatum.

Z. angustum, depressum, omnino nitide fulvum, breviter pilosum; prothorace obsoleto quadri-tuberculato; elytris parallelis, irregulariter subtiliter punctatis. Long. 6 lin.

Hab. Natal.

Narrow and depressed, everywhere glossy fulvous, with short inconspicuous hairs; head and prothorax finely but not closely punctured, the latter with four very faintly-marked tubercles, the base fringed with short greyish hairs; scutellum small, scutiform; lytra parallel, finely and irregularly punctured; abdomen covered with long golden hairs.

The coloration and narrower outline will at once distinguish this species.

Xystrocera promecoides.

X. angusta, cyanea, subnitida, antennis nigris; elytris confertim punctatis, pedibus tenuatis; femoribus clavatis, vix compressis. Long. 6 lin.

Hab. Malacca (Patani).

Narrow, dark blue, somewhat glossy, head and prothorax lighter, the latter subtransverse, slightly bicallous on each side; antennæ black, setose beneath; scutellum inconspicuous; elytra not broader than the prothorax, very closely [illegible] punctured, the apex entire; legs slender, [illegible], hind femora scarcely compressed, slightly exten[illegible]eyond the body; body beneath brilliant blue; propect[illegible]ely punctured.

Allie[illegible] X. *alcyonea*, but, *inter alia*, its very slender legs will a[illegible]once distinguish it. It has a marked resemblance to c[illegible]in species of *Promeces*.

Bethelium puncticolle.

B. angustum, testaceo-piceum; prothorace ovato, fortiter areolato-punctato; elytris parallelis, flavescenti-bifasciatis; femoribus brevibus, pedunculatis. Long. 2 lin.

Hab. Fremantle (Western Australia).

Narrow, sparsely hairy, testaceous-pitchy; head rugose; eyes distant above; antennæ slender; prothorax ovate, somewhat longer than broad, with areolated coarse punctures; scutellum scutiform; elytra parallel, unevenly depressed, and irregularly punctured, each with two pale yellowish bands, the first—antemedian—not meeting at the suture, the second—postmedian—oblique; femora short, pedunculate.

A narrower species than its congeners, and with an oblong prothorax, not so gradually constricted at the base, and coarsely and somewhat peculiarly punctured.

Zathecus Batesii.

Z. oblongus, parce pubescens, testaceus, capite, prothorace lineisque elytrorum piceis; prothorace utrinque modice rotundato; elytris singulis lineis duabus elevatis testaceis. Long. 9 lin.

Hab. Aguana (Ecuador).

Oblong, sparingly pubescent, testaceous, the head, prothorax, and lines on the elytra pitchy; antennæ much longer than body, joints, except the first two and last two, brown at the apex; prothorax uneven, rounded from the anterior third, its disk with five oblong tubercles (:·:); scutellum triangular; elytra irregularly punctured, each with two raised lines, the outer well-marked, nearly prolonged to the apex, the inner very slight and confined to the base; body beneath and apical half of the femora chestnut-brown; mesosternum triangular.

Mr. Bates pointed out this species to me as a new member of his genus *Zathecus* (Entom. M. Mag., iv., p. 26, 1867), differing from his *Z. graphites* in coloration and sculpture. The upper surface has a varnished appearance; the raised lines on the elytra are semi-transparent, and are entirely testaceous.

Ceresium lineigerum.

C. brunneo-testaceum; prothorace cylindrico, lateribus vix rotundatis, basi quam apice haud latiore; elytris parallelis, lineis

albo-pilosis longitudinaliter indutis; femoribus modice crassis. Long. 6 lin.

Hab. Queensland.

Brownish testaceous; upper surface finely punctured; antennæ rather shorter than the body, third and fifth joints longest, sixth and seventh equal and shorter, the rest gradually shorter; prothorax nearly cylindrical, sparsely pubescent, the base not broader than the apex; scutellum semicircular; elytra parallel, rounded at the apex, each with six or seven longitudinal lines of obliquely-placed white hairs, those at the side and apex not in lines; body beneath and legs sparsely pubescent; femora moderately stout.

The well-developed lines of obliquely-placed hairs are characteristic of this species.

Pempsamacra argentata.

P. fusca, squamis subargenteis tecta; prothorace oblongo, lateribus in medio paulo rotundatis; antennis longiusculis, articulis 3, 4, 5 tenuatis, sequentibus conjunctim clavatis. Long. 4 lin.

Hab. Eclipse Island (Australia).

Allied to *P. subaurea*, but with longer antennæ, especially the third, fourth, and fifth joints, which are also obviously more slender, the remaining joints forming the club less compact, and the prothorax more oblong; head, prothorax, and elytra finely and closely punctured, covered with yellowish metallic scales, with a brown spot in the middle of each, and another near the apex; scutellum transverse and slightly rounded behind; apical half of the fifth joint of the antennæ silvery.

Pempsamacra condita.

P. fulva, squamis aureis parvis aspersa; prothorace minus angusto, basi constricto; antennis longiusculis articulis 3—8 tenuatis, sequentibus tribus conjunctim clavatis. Long. 4¼ lin.

Hab. Queensland.

Fulvous, sprinkled with small golden scales, the upper surface minutely punctured, the intervals raised; antennæ rather long, the third, fourth, and fifth joints longest, the sixth, seventh, and eighth gradually shorter, the last three forming a well-marked club; prothorax scarcely longer than broad, slightly rounded at the sides, constricted at the base; scutellum triangular; elytra moderately broad, an antemedian spot of golden scales on each; body beneath and legs with silvery scales.

This species may be placed near *P. pygmæa*, which has stouter antennæ not clubbed as in the species here described.

Mecaspis simulatrix.

M. elongata, violacea, antennis nigris; scutello valde elongato, lævi; femoribus muticis; corpore infra ad latera argenteo-pubescente. Long. 11 lin.

Hab. West Africa.

Closely allied to *M. violacea*, but with all the femora entire, and the scutellum smooth, not transversely corrugated, the third joint of the antennæ as long as the two next together; prothorax transverse, with two broad impressions on each side; elytra minutely punctured; body beneath glossy violet, the sides of the metathorax and of the abdominal segments with thin silvery pubescence; femora and tibiæ violet, tarsi with white pubescence.

Mecaspis dives.

M. nitidissime aureo-cuprea; prothorace disco rugoso-elevato; scutello transversim plicato; elytris ampliatis; segmento ultimo abdominis paulo emarginato. Long. 16 lin.

Hab. Delagoa Bay.

Very glossy golden copper, the elytra varying to green; antennæ black, a little more than half the length of the body, the third joint as long as the two next together; prothorax with a large conical spine on each side, the disk elevated into two slightly corrugated callosities; scutellum transversely wrinkled; elytra broad, finely punctured, the sides with a slightly expanded margin; femora glossy luteous, blackish at the apex, the middle femora emarginate beneath; intermediate and posterior tarsi with a whitish pile; body beneath golden, varying to coppery; last abdominal segment slightly emarginate.

In the broad elytra this species agrees with *M. explanata*, but it has no "velutine" patches nor stripes. The specimen here described is a female.

Promeces auratus.

P. angustus, viridi-aureus, antennis—articulo basali excepto—tarsisque nigricantibus; prothorace in medio et ad basin latiore. Long. 8 lin.

Hab. Grahamstown.

Closely allied to *P. longipes*, but more richly coloured, the prothorax broader in the middle, and the base much broader than the apex; the antennæ of the male more than twice as long as the body, the last five joints especially longer compared to the same joints in *P. longipes*.

Promeces longicollis.

P. angustior, nitide viridis vel cyaneus, antennis nigris; prothorace elongato, tenuato, disperse punctato; elytris corrugatis, dense punctatis. Long. 5 lin.

Hab. Natal.

Allied to *P. viridis*, but at once distinguished by its much longer and narrower prothorax, not densely punctured, and its longer muzzle. Colour as to violet, green, or dark blue, is subject to vary.

Promeces austerus.

P. (♀) elongatus, saturate cyaneus; prothorace æreo-viridi; antennis nigris, articulo ultimo subulato; corpore infra viridi; femoribus nitide violaceis. Long. 9 lin.

Hab. Natal.

Elongate, dark blue, nearly opaque, prothorax brassy green, antennæ black; body beneath glossy green; femora dark blue or violet, the four anterior strongly clavate, the posterior, as well as their tibiæ, long and slender; head and basal joint of the antennæ coarsely punctured; antennæ longer than the body (♀?), moderately thicker upward, the last joint subulate, scarcely longer than the preceding one; prothorax stout, rounded at the sides; scutellum triangular; elytra closely and minutely punctured, a faint longitudinal line on each; under surface glossy blue, abdominal segments with their posterior margins black.

A somewhat dull-coloured species, the prothorax only slightly glossy, and in a certain light blackish. The male of *P. longipes* has 12-jointed antennæ; species with eleven joints Lacordaire would exclude from the genus. Fåhræus has apparently done so in his genus *Hypocrites*, but, until we know the sexes of all the species, I am not disposed to adopt it. *Promecidus* of the same author is not adopted in the Munich Catalogue.

Eroschema affine.

E. angustum, atrum, infra nitidum, prothorace, scutello, elytrisque rubris; scutello triangulari; antennis articulis 6—11 attenuatis. Long. 5½ lin.

Hab. Queensland.

Allied to *E. Poweri*, but narrower, the prothorax and scutellum the same colour as the elytra, the antennæ with the joints from the sixth to the eleventh inclusive more slender and cylindrical, and the scutellum triangular, not broad and rounded behind. The elytra have four strongly raised lines on each, exactly as in *E. Poweri*, with the intervals strongly punctured; the body beneath is also glossy black.

ICARIOTIS.

Caput ante oculos breve; clypeus distinctus. Antennæ setaceæ, corpore longiores, prope oculos insertæ, articulis tertio quartoque breviusculis, scapo claviformi, vix elongato. Oculi ovati, supra distantes, subtenuiter granulati. Prothorax oblongus, inermis. Elytra subtrigona, humeris prominulis. Pedes sat elongati; femora clavata, mutica; tibiæ rectæ; tarsi elongati, validi; unguiculi tenues. Metasternum breviusculum. Coxæ anticæ separatæ; posticæ contiguæ.

This genus differs from *Toxotus* principally in the form of the prothorax, which is rounded at the sides, and not dilated at the base; the female, however, of *I. scapularis* has a rather conspicuous tubercle at the sides. The antennæ of the three species here described are somewhat variable.

Icariotis unicolor.

I. opaca, omnino nigrescens, pube pallide silacea leviter induta; elytris lineis tribus fere obsoletis instructis; antennis (♂) corpore paulo longioribus, articulis tertio quartoque æqualibus. Long. 6 lin.

Hab. Madagascar.

Dull brownish black, with a thin silaceous pubescence; head and prothorax finely and closely punctured, the latter rather longer than broad, the disk slightly convex on each side; scutellum triangular, covered with coarse white hairs; elytra much narrower towards the subtruncate apex, each with three nearly obsolete longitudinal lines; body beneath and legs with pale greyish pubescence; the hind femora extending a little beyond the elytra.

The claw-joint is very slender at the base, but scarcely spatulate as in *Logisticus rostratus*; the usually minute joint at its base—really the *fourth*—is very conspicuous. The pubescence to the naked eyes has a whitish appearance.

Icariotis fulvicornis.

I. nigricans, pube brevi albida induta; antennis corpore brevioribus, articulis a tertio fulvis; elytris a basi fere ad apicem late sulcatis. Long. 5 lin.

Hab. Madagascar.

Blackish, with short whitish pubescence; antennæ fulvous from the third joint; head and prothorax finely and closely punctured, the latter scarcely longer than broad, the base not narrowed; scutellum rounded at the apex; elytra moderately narrower towards the somewhat obliquely truncate apex, each with a groove-like depression from the base, gradually growing fainter posteriorly; body beneath with silvery pubescence; hind femora not passing beyond the elytra.

Allied to *I. unicolor*, but with shorter femora, grooved elytra, and fulvous antennæ. My specimen is apparently a male.

Icariotis scapularis. (Pl. XIV., fig. 4).

I. subnitide nigra, humeris luteis, pube tenuissima induta; elytris haud lineatis; antennis (♂) corpore paulo longioribus, articulis tertio quartoque brevioribus, fere æqualibus. Long. 4 lin.

Hab. Madagascar.

Narrower than the last, black, slightly glossy, with minute scattered pubescence; head and prothorax finely and closely punctured, the latter conspicuously longer than broad, the disk with a small tubercle on each side at the base; scutellum triangular, covered with whitish hairs; elytra minutely punctured, without raised lines, the apex truncate; body beneath and legs with a sparse ashy pile.

What I take to be the female, has shorter and more linear antennæ, the third joint nearly twice as long as the second, and the apex of each elytron spined at the sutural angle; it is also much larger, the prothorax broader, with a distinct tubercle on each side. It may possibly be the female of another species. I have another species with much larger eyes, &c., but with imperfect antennæ.

Eccrisis.

Caput ante oculos elongatum. Oculi ovati, supra distantes. Antennæ lineares, ad oculos haud contiguæ; scapo paulo elongato, curvato; articulis tertio quartoque brevibus. Prothorax oblongus, inermis, supra valde convexus, basi expansus. Elytra subtrigona, ad suturam postice divergentia, humeris prominulis. Pedes mediocres; femora clavata, intermedia et postica subtus dentata; tibiæ rectæ; tarsi graciles. Coxæ anticæ fere contiguæ. Mesosternum convexum, inter coxas declive.

In *Anthribola*—to which *Eccrisis* is nearly allied—the elytra are dehiscent from the base, and the scape, longer and nearly straight, extends nearly to the posterior margin of the eye. The specimen here described is probably a female.

Eccrisis abdominalis. (Pl. XIV., fig. 3).

E. opacus, nigrescens, elytris fuliginosis; abdomine subnitide nigro, segmento primo basi dense ochraceo-pubescente; femoribus posticis basi testaceis. Long. 7 lin.

Hab. Madagascar.

Dull blackish, thinly pubescent; antennæ about half the length of the body, the scape extending to about the middle of the eye, the third and fourth joints short and nearly equal, the remainder, except the last two, longer and thicker, the fifth longest; head and prothorax finely and closely punctured; scutellum triangular; elytra smoky-brown, shoulders prominent, posterior two-thirds of the suture incurved, the divergent portion subulate, and its inner margin at the base with a pale yellowish pubescence; posterior femora testaceous at the base; abdomen glossy black, the first segment covered at the base with ochreous scale-like hairs.

Aphelledes.

Caput breve; palpi securiformes. Oculi leviter emarginati, infra distantes, grosse granulati. Antennæ setaceæ, ad oculos contiguæ. Prothorax oblongus, utrinque spinosus. Elytra subcuneata, apicibus rotundatis. Pedes modice elongati; femora paulo incrassata; tibiæ rectæ, elongatæ; tarsi angusti, elongati; unguiculi vix divergentes. Abdomen breviusculum.

This genus is differentiated from all the genera of *Toxotinæ*, to which it belongs, in its emarginate eyes, and the insertion of the antennæ close to them. The

species described below has a dense pubescence, accompanied on the elytra with scattered erect white hairs.

Apheledes velutinus. (Pl. XIV., fig. 9).

A. subelongatus, niger, supra pube subtilissima rufo-fusca tectus; prothorace ad latera longitudinaliter trituberculato; elytris apice albo-marginatis. Long. 8 lin.

Hab. Madagascar.

Subelongate, black, with a reddish-brown, closely-set pubescence; head with an annular impression between the antennæ, the sides above the mouth with a fascicle of longish white hairs; antennæ pubescent, all the joints from the fourth nearly equal in length; prothorax subcylindrical, with a longitudinal row of three blackish tubercles towards each side; scutellum rounded behind; elytra much broader at the base than the prothorax, gradually narrowing from the shoulders, the apex of each rounded and bordered with a narrow line of white hairs; body beneath and legs with a pale silky pubescence.

ANTIGENES.

Caput exsertum, haud rostratum; oculi reniformes, laterales. Antennæ corpore breviores, setaceæ, prope oculos insertæ. Prothorax ad latera tuberculatus. Elytra parallela, leviter convexa. Coxæ anticæ productæ, separatæ. Pedes graciles; tibiæ calcaratæ; tarsi articulo ultimo elongato; unguiculi tenuati, approximati. Mesosternum depressum. Abdomen segmentis tribus basalibus longitudine æqualibus.

An ambiguous genus, for which, I think, no better place can be found than among the *Lepturinæ*, and those forms which Lacordaire calls the "Toxotides." There is a peculiarity in the long, slender, and approximate claws.

Antigenes funebris. (Pl. XIV., fig. 1).

A. oblongus, obscure niger, capite postico, prothoraceque in medio et margine antico rufis; elytris pube brevissima flava leviter tectis. Long. 6 lin.

Hab. Madagascar.

Oblong, dull black, on the elytra a very short yellowish pubescence, giving them a brownish tint; the back of the head, anterior margin, and disk of the prothorax in the middle, yellowish red; head with a transverse impression in front, clypeus fringed with

silaceous hairs; antennæ black, third and fourth joints equal in length, the following longer, slightly angular at the apices; prothorax slightly longer than broad, with a stout conical tubercle on each side; scutellum small, triangular; elytra much broader at the base than the prothorax, apex broadly rounded; legs black, pro- and mesosterna reddish.

Psaromaia Renei.

P. oblonga, nigra, pube alba tenuiter tecta; antennis nigro-annulatis; elytris conspicue punctatis, basi granulis nitidis nigris instructa. Long. 10 lin.

Hab. Kodeicanol Mts. (Southern India).

Oblong, black, thinly covered with delicate white pubescence; head grooved between the eyes; antennæ not longer than the body, all the joints, except the first, black at the tips; prothorax very transverse, sharply spined on each side, a few irregularly scattered punctures on the disk; scutellum cordiform; elytra subcylindrical, with numerous conspicuous glossy black punctures, and with ten or twelve granules—also glossy black—at the base of each; body beneath and legs with a denser white pubescence.

This species has all the characters of *Psaromaia*, except that the mesosternum is rather less elevated. The genus without doubt belongs to the *Monochamus* group. I am indebted for my specimens to M. René Oberthur.

ERYALUS.

Tuberes antennarum breves, basi contiguæ. Pedes longitudine æquales. Mesosternum productum. Cæteris fere ut in *Monochamo*.

The short antennary tubercles, contiguous at the base, and, necessarily the approximation of the antennæ, together with the elevated mesosternum, are characters which are not found—so far as I am aware—in any other of the *Monochamus* forms. The exponent of the genus is remarkable for the way in which the pubescence on the elytra is cut up into numerous well-defined irregular spots.

Eryalus polyspilus (Pl. XIV., fig. 10).

E. oblongus, pube pallide grisea omnino denso tectus, sed lineis numerosis irregularibus, plerumque transversis, notatus; prothorace spina lata brevi armato. Long. 15 lin.

Hab. Sumatra.

Oblong, a pale greyish pubescence throughout, interrupted above by numerous well-defined flexuous or irregular mostly transverse blackish lines; front and cheeks with vertical and oblique lines; lower lobe of the eye small; antennæ much longer than the body, the third joint longest, the rest to the tenth very gradually shorter, the last nearly as long as the third and subulate; prothorax deeply grooved anteriorly, the sides with a short broad spine; scutellum scutiform; elytra much broader than the prothorax at the base, gradually narrower to the apices, shoulders not produced; legs rather short; tibiæ nearly straight; tarsi gradually broader to the third joint.

GRYNEX.

Caput antice breve, transversum; oculi fortiter emarginati, supra distantes, grosse granulati. Antennæ setaceæ, corpore breviores, articulo basali pyriformi. Prothorax ad latera spinosus. Elytra prothorace latiora, cuneiformia, ad apicem intus oblique scissa. Pedes mediocres; femora mutica, modice crassa; tibiæ intermediæ emarginatæ; tarsi æquales, breviusculi. Pro- et mesosterna elevata. Abdomen segmentis quatuor basalibus gradatim brevioribus.

The exponent of this genus has a peculiar facies, not unlike *Pterichthya*, but its characters, except for its shorter antennæ, agree more with the *Homonœa* group. The anterior cotyloid cavity is prolonged into a narrow slit externally. I owe my specimen to M. René Oberthür, who received this and many other novelties from his collector, M. Castets.

Grynex lineatus. (Pl. XIV., fig. 2).

G. oblongus, postice gradatim angustior, fusco-piceus, lineis pubescentibus griseis ornatus; prothorace spina conspicua pone medium instructo. Long. 7 lin.

Hab. Kodeicanel Mts. (Southern India).

Oblong, gradually narrower posteriorly, pitchy-brown, sparingly pubescent, but the pubescence condensed into greyish lines on the prothorax and elytra—*sc.* a line on each side of the former continued on the base of the latter, followed by two narrower lines, the outer terminating towards the apex; head with few punctures, an impressed line in front; antennæ with the third joint nearly twice as long as the first, the rest gradually shorter; prothorax transverse, slightly punctured; scutellum small, twice as broad as long; elytra broader at the base than the prothorax, slightly rounded at

the sides, and tapering to an obtuse point at the apex, the scutellary region somewhat concave and conspicuously punctured; legs pubescent, all the tarsi of nearly equal length; body beneath glossy brown, all the abdominal segments with a pubescent spot on each side.

Grammœchus ligatus.

G. oblongus, fuscus subnitidus, antennis pedibusque brunneis, supra albo-lineatus, *sc.* prothorace una linea utrinque ad medium elytrorum prolongata, una transversa pone medium, alteraque obliqua posticis. Long. 4½—6 lin.

Hab. Labuan.

Oblong, dark brown, slightly nitid, antennæ and legs reddish brown, marked above with narrow white lines, on the prothorax one on each side of the disk prolonged to the middle of the elytra, a transverse arched band behind the middle and another oblique line towards the apex; prothorax transverse, rounded posteriorly, and finely corrugated; scutellum semicircular; elytra loosely punctured; body beneath and legs finely pubescent.

G. polygrammus, Thoms. (Syst. Ceramb., p. 59), has a longer prothorax, the sides fully rounded, nearly smooth, and with two median lines in addition; and the elytra are relatively longer. In redescribing the genus (Trans. Ent. Soc. Lond., ser. 3, vol. iii., p. 681), I used the words "Elytra trigonata," but this only applies to the male; "cuneata" would have been better.

Ecyroschema rugata.

E. oblongo-cylindrica, indumento obscure fuscescente tecta; prothorace latitudine et longitudine fere æquali; elytris lineis interruptis elevatis transversis, quasi reticulatis, munitis. Long. 4 lin.

Hab. N'Gami.

Oblong, cylindrical, covered with a dull brownish indumentum; head slightly convex and produced in front of the eyes, rising above into two well-marked vertical and approximate tubercles; antennæ much shorter than the body, the second joint contracted at the base (cyathiform), the first three much shorter than the rest together; prothorax nearly equal in length and breadth, cylindrical, thinly punctured, the disk with two prominent nearly median tubercles; scutellum transverse, broadly rounded behind; elytra much broader than the prothorax, parallel at the sides, with stout transverse interrupted ridges occasionally connected by longitudinal ones, the intervals punctured; legs short; anterior coxæ with a

short spine directed inwardly; penultimate joint of the tarsi deeply bilobed, the last joint broader from the base, claws divaricate.

It is with some hesitation that I refer this species to *Echyroschema* (Thoms., Syst. Ceramb., p. 48), as Lacordaire (Gen., ix., p. 503) gives "divergent antennary tubercles" as one of the characters of the genus, nor does M. Thomson, who devotes less than two lines to the description of the species (*E. favosa*), nor, indeed, to any of the characters given above. In the remarkable net-like sculpture of the elytra and the two callosities at their base, as well as the shortness of the antennæ, the two species agree. It may be added that the legs are furnished with short stout hairs resembling small granules.

Atybe nigritarsis.

A. oblonga, picea, fusco pubescens, fasciculata, medio elytrorum griseo; prothorace basi quam apice latiori; tibiis intermediis et posticis medio apicali, tarsisque nigris. Long. 8 lin.

Hab. Madagascar.

Closely resembling *A. Plantii* (Pascoe, Journ. Ent., vol. ii., p. 281, pl. 13, fig. 6), but with broader tarsi, a stouter scape, and with the sides behind the middle nearly parallel and rather broader at the base than at the apex, the minute spines on the disk of the prothorax of the former being replaced by nearly obsolete tubercles, the broad band on the elytra greyish or ashy, with scattered punctures; femora at the apex and tibiæ whitish, tarsi deep black; abdominal segments—except the last—with two spots at the margins; composed of reddish-brown hairs.

Ropica cylindrica.

R. attenuata, fusca, pilis brevibus griseis omnino tecta; prothorace cylindrico elongato; elytris parallelis elongatis, apicibus truncatis, pone medium fascia pallida fere obsoleta notatis. Long. 5 lin.

Hab. India.

Narrow, dark brown, everywhere covered with short greyish hairs; head concave between the antennary tubercles; antennæ scarcely longer than the body; scape rather stout, cyathiform; prothorax cylindrical, much longer than broad, coarsely and remotely punctate; scutellum semicircular; elytra elongate, parallel, the apex of each somewhat obliquely truncate, seriato-punctate, the punctures larger at the base, behind the middle a

broad oblique pale and almost obsolete band; femora moderately stout.

Differs from the other species of the genus in its narrow elongate form, the concave front caused by the divergence of the antennary tubercles, and the less approximate anterior coxæ.

Amblesthis geminus.

A. elongatus, pube grisea, elytrorum basi excepta, dense vestitus; prothorace utrinque spina anguste-cylindrica armato, dorso tuberculis quatuor munito; elytris apice singulatim rotundatis. Long. 7 lin.

Hab. Grahamstown (S. Africa).

Elongate, densely covered with a greyish pubescence, the base of the elytra excepted; a deeply impressed line between the eyes and on the vertex; antennæ with the fourth to the tenth joints brownish towards the apex; prothorax about as long as broad, the sides with a narrowly cylindrical spine, and with two approximate tubercles on each side of the disk; scutellum indistinct; elytra rather more than three times as long as the prothorax, the apex of each rounded, at the base a large triangular naked patch, thickly punctured; body beneath with a grey pubescence.

Form and size of *A. alutacea*, but with a large triangular patch on the base of the elytra, as in *Amblesthidus plagiatus*. *Amblesthidus*, Fahr., differs from *Amblesthis* in having the antennary tubercles approximate, and in its narrower form.

Sophronica reducta.

S. brunnea (prothorace fusco) pallide griseo pilosa; scapo antennarum breviusculo; prothorace valde transverso, basi quam apice multo latiore; elytris latiusculis. Long. 3 lin.

Hab. Grahamstown.

Yellowish brown (prothorax dark brown), with long greyish hairs; upper surface coarsely punctured; eyes widely apart; scape of the antennæ rather short, ovate-oblong, third joint much shorter; prothorax very transverse, the base much broader than the apex; scutellum truncate behind; elytra rather short, broader than the prothorax; abdominal segments glossy, with the sides pubescent.

In *S. carbonaria*—to which the above is allied—the base of the prothorax is narrower than the apex, and the eyes are not so coarsely granulate as in that species.

Sophronica amplipennis.

S. fusco-picea, albo-pilosa; scapo antennarum elongato; prothorace parvo, modico transverso, lateribus rotundato; elytris elongatis, convexis, prothorace multo latioribus. Long. 5 lin.

Hab. Angola.

Oblong, pitchy brown, with long white hairs; head small, eyes approximating above; scape of the antennæ elongate, somewhat fusiform; prothorax small, rounded at the sides; scutellum broad, truncate behind; elytra long, much broader than the prothorax, convex, with coarse distant punctures; body beneath slightly pubescent.

A very distinct species, remarkable for the size of its elytra. The eyes are very coarsely granulate.

Sophronica oblonga.

S. anguste oblonga, nitide fusco-nigra, leviter pilosa; prothorace modice transverso, lateribus angulato-rotundato; elytris prothorace paulo latioribus. Long. 4 lin.

Hab. Grahamstown.

Narrowly oblong, glossy pitchy black, with slender blackish hairs; head broad, eyes distant above; scape of the antennæ moderately long, cylindrical; prothorax transverse, rounded and slightly angulate at the sides; scutellum broad, rounded behind; elytra not much broader than the middle of the prothorax; body beneath pitchy; anus fulvous.

A narrow form with a fulvous anus, as in *S. calceata*, but without the sutural stria. These three species are all coarsely and irregularly punctured; the eyes with large facets, and the antennæ scarcely more than half the length of the body.

Corus.

Sophronicæ affinis, sed antennæ setaceæ, haud pilosæ; coxæ anticæ transversæ; et prosternum elevatum. Caput late, breve. Scapus antennarum breviusculus, subcylindricus. Prothorax spina minuta laterali instructus. Pedes breves, æquales; tarsi articulis tribus basalibus latis, unguiculis divaricatis.

In facies generally resembling *Sophronica*, but its large transverse anterior coxæ and elevated prosternum on a level with them is an important structural peculiarity. The setaceous antennæ, free of the long hairs characterising *Sophronica*, is perhaps less important.

Corus annulicornis.

C. robustus, supra subnitido nigor; antennis albo-annulatis, articulis tertio quartoque conjunctis sequentibus fere longitudine æqualibus. Long. 4 lin.

Hab. Grahamstown.

Stout, moderately glossy, black, slightly pubescent; head and prothorax coarsely punctured; antennæ much shorter than the body, the second and succeeding joints ringed at the apex with close-set coarse white hairs; prothorax transverse, a minute spine towards the base on each side; scutellum semicircular; elytra subcylindrical, rounded at the apex, the surface with large irregular but shallow sparsely-punctured depressions; body beneath and legs pitchy.

Pachypeza marginata.

P. elongata, picea, sparse pubescens; prothorace basi quam apice latiore, vitta alba laterali ornata; elytris subparallelis ad latera albo-marginatis. Long. 8 lin.

Hab. Brazil.

Elongate, pitchy brown, sparsely pubescent; head with two fulvous lines in front between the eyes; antennæ longer than the body, uniformly ciliated beneath; prothorax longer than broad, and broader at the base than at the apex, transversely wrinkled, a white stripe at the side continued to the eye; scutellum transverse; elytra nearly parallel, closely punctured, and sprinkled with small silaceous spots, the outer margin edged with pure white; epipleura of the meso- and metathorax also pure white and continuous with the stripe on the prothorax; body beneath with a fulvous pubescence.

This species differs from *P. pennicornis* in its shorter antennæ, uniformly ciliated throughout; its only moderately compressed and comparatively longer tibiæ; and coarser punctuation.

Pachypeza teres.

P. angusto elongata, picea, supra pube silacea albaque vittatim ornata; elytris cylindricis, haud albo-marginatis; pedibus brevissimis. Long. 6 lin.

Hab. Brazil.

Narrowly elongate, pitchy, with sparse pubescence, which on the prothorax and elytra is condensed into narrow silaceous and whitish stripes; antennæ as in the last; prothorax longer than broad, slightly wrinkled; elytra parallel, closely punctured, sides unicolorous: legs very short, the posterior pair not extending beyond the abdomen; epipleura of the meso- and metasterna pure white.

A narrower species than the last, the prothorax less wrinkled and not broader at the base than at the apex; the elytra without the margins, &c. *Pachypeza trivittata*, Newm. ('Entomologist,' p. 382), from the Philippine Islands, is probably a *Pothyne*.

Sparna macilenta. (Pl. XIV., fig. 5).

S. angusta, nigra, dimidio postico elytrorum fulvo; antennis articulo basali quam articulis tertio, quarto, quintoque conjunctis vix breviore. Long. 4½ lin.

Hab. Sarayacu (Ecuador).

Narrow, black, not shining, the posterior half—or thereabouts—of the elytra brownish yellow; antennæ slender, but the first joint stout, hairy beneath, and as long as the third, fourth and fifth joints taken together, the fourth yellowish, black only towards the apex: each elytron with two raised lines, the apex with an acute spine on the outer margin; body beneath and femora, except at the base, glossy black.

The character "elytra suturæ hiantia" (Thomson, Syst. Ceramb., p. 30) appears to me to be due to an accidental divergence as often happens, and is not mentioned by Lacordaire. *S. lycoides*, the type, has a superficial resemblance, especially as regards colour, to certain *Lyci*, but this species fails in that respect, being a narrow form with the elytra only moderately dilated towards the apex; the third joint of the antennæ is scarcely stouter than the fourth, in which it disagrees

with the character of the genus as given by Lacordaire and Thomson, but as it appears to me, this is very little stouter than the fourth, and is partially due to its hairiness beneath. The prothorax is alike in both species.

Chrysaperda collaris.

C. mediocriter oblonga, supra nitida, flava, capite, margineque apicali prothoracis nigris; elytris parallelis, apice et margine externo exceptis, nigro-cyaneis; antennis testaceis, versus apicem infuscatis. Long. 5 lin.

Hab. Sarayacu (Ecuador).

Moderately oblong, glossy above, head, except a small portion above the clypeus, and anterior margin of the prothorax black, rest of the prothorax reddish yellow; elytra closely punctured, blackish blue, the apex and exterior margins whitish; antennæ and legs pale testaceous, the former finely setose, the basal joint with a black longitudinal line on the inner side, the last three apical joints brown; body beneath fulvous; mesosternum blackish.

This species was pointed out to me by Mr. Bates as a second member of his genus *Chrysaperda* (Ann. and Mag. Nat. Hist., ser. 5, vol. viii., p. 152). It seems closely allied to *C. metallica*.

Glenea Celia.

G. læte cærulea, elytris nigro-plagiatis; antennis nigris, articulis tribus basalibus exceptis, prothorace in medio linea nitido nigra notato. Long. 7 lin.

Hab. Sumatra.

Clear cobalt-blue, the elytra with black patches; antennæ black, except the three basal joints; prothorax convex, the sides rounded, finely punctured, the middle with a short glossy black line; scutellum scutiform, the apex slightly bilobed; elytra with larger dispersed punctures, flattish, each with two spines at the apex, the inner short, and with two large black patches on the basal half, and two smaller patches or spots posteriorly—eight altogether—legs and body beneath blue, the metasternum with a black curved band.

There is no other *Glenea* known to me, to which I can approximate this species.

Volumnia morosa.

V. oblonga, brunnea, griseo-varia, antennis nigris, scutello brunneo; elytris basi fere obsolete punctatis. Long. 3 lin.

Hab. Angola.

Oblong, brown varied with a greyish pubescence, *sc.* a stripe on each side of the prothorax continued obliquely on the elytra, but not quite meeting at the suture, a broad band in the middle narrowly prolonged down the suture and spreading out at the apex; head brown, except two reddish-grey stripes in front; prothorax slightly punctured; elytra on the basal half and towards the apex nearly obsoletely punctured, the band only showing a few small but distinct punctures, apex of each elytron rounded, but with a minute spine on the outer side; body beneath with a coarse reddish pubescence on each side, but with a naked spot on the abdominal segments.

In *V. Westermanni* the very pale grey is differently disposed, the antennæ are ringed with white, the three basal joints are conspicuously shorter, the base of the elytra is very coarsely punctured, &c. Mr Gahan thinks that all other species hitherto referred to *Volumnia* belong to *Glenea*. Although Lacordaire places the first in his "tribu Phytœciides," and the latter in his "tribu Lamiidés vrais," it would be difficult to say where, taken as a whole, they differ. *Glenea*, however, has a different facies to *Volumnia*, and more slender legs and antennæ.

OCHRÆSIUS.

Caput antice breve, quadratum: tuberes antennarum divergentes. Oculi supra distantes, tenuiter granulati. Antennæ scapo crasso, subcylindrico, cicatrice obsoleta, articulo tertio quam scapo vix breviore, cæteris gradatim brevioribus. Prothorax brevinsculus, cylindricus. Elytra elongata, prothorace basi multo latiora, ad apicem gradatim angustiora. Pedes breves; femora leviter incrassata, mutica; tibiæ rectæ; tarsi latiusculi; unguiculi haud divergentes, fissiles. Sterna angusta.

Mr. Bates has an undescribed species of *Æreniea*, which bears a slight resemblance to this fine species, but this has much shorter legs, the hind tibiæ not extending beyond the fourth abdominal segment, the tarsi broader, and the third joint strongly lobed.

Ochræsius sticticus. (Pl. XIV., fig. 8).

O. elongatus, pube flavescenti sat dense tectus; elytris basi confertim punctatis, punctis nitidis, aliis conspicuis dispersis, apice singulorum acute spinoso. Long. 15 lin.

Hab. St. Catharine's (Brazil).

Elongate, black, nitid, rather closely covered with a pale brownish yellow pubescence; head and prothorax finely punctured, the latter shorter than the breadth; antennæ rather longer than the body, pubescent, with short slender hairs beneath; scutellum semicircular; elytra about five times longer than the prothorax, and nearly twice as broad at the base, the apex of each terminating in an acute spine, the base closely punctured, also some granules near the scutellum, the rest of the elytra with larger and irregularly scattered punctures; body beneath and legs finely pubescent.

Orica.

This generic name is proposed for "*Zygocera? albovirgata*" of Fairmaire ('Le Naturaliste,' Jan. 15, 1888, p. 23, with fig.). I place the genus in the "Phrynetides" of Lacordaire, but it differs from all the other genera of the "groupe" in the antennæ, the basal joint being oblong-pyriform, the fourth—and longest—slender and curved, the remainder short and gradually thicker to the last, which, from the middle, is suddenly and shortly subulate; the intermediate tibiæ are notched, as in *Pachystola*, while the coloration approximates it to *Mallonia albo-signata*. It is from Madagascar. *Zygocera* of Dejean's Catalogue was first characterised by Erichson (Wiegm. Arch., 1842, p. 223) with *Z. cænosa* as the type, but merely in an incidental way, so that Thomson first (Essai, p. 111), then Westwood (Trans. Ent. Soc. Lond., ser. 3, vol. i., p. 626), and lastly Lacordaire (Gen. Coleopt., t. ix., p. 499) ignored his description, each giving one of his own; Thomson's, however, was founded on Newman's *Callipyrga*, as he, himself, afterwards recognised.

Syennesis.

♂. Caput breve; oculi infra et supra fere contigui; palpi maxillares articulo ultimo breviter subtriangulari. Antennæ elongatæ, articulo basali pone oculos extenso, tertio et sequentibus sulcatis et apice intus productis. Prothorax brevis, ad latera angulatus.

Elytra oblonga, apicibus integris. Pedes graciles; coxæ anticæ exertæ, approximatæ; femora linearia, compressa; tarsi angusti. Abdomen segmentis longitudine fere æqualibus. Processus interfemoralis angustus.

♀. Caput magnum, breve; oculi supra haud approximati; infra valde distantes; palpi breves. Antennæ corpore breviores, lævigatæ, haud sulcatæ, apices integri. Prothorax brevis, antice latior. Elytra depressa, apicibus rotundatis abdomine breviora. Tarsi minus angusti. Abdomen segmentis primo ad quartum gradatim brevioribus. Processus interfemoralis latus.

As will be seen from the above, there is a very considerable difference between the sexes, but not more than occurs between several other genera of *Prionidæ;* and it is, I think, one reason why they should be treated as a family rather than as a subordinate group. I refer this genus to the neighbourhood of *Monodesmus*, the female of which is unknown according to Lacordaire, although Serville speaks of the two sexes as having similar antennæ.

Syennesis dispar. (Pl. XIV., figs. 6, ♂, 7, ♀).

♂. S. oblongus, piceo-fuscus, antennis corpore infra, pedibusque pallidioribus, his pubescentibus; prothorace rude et subconfertim punctato. Long. 9 lin.

♀. Latior, omnino rufo-castaneus, nitidus; prothorace leviter et sat parce punctato; elytris depressis, minus punctatis, basi prothoracis vix latioribus. Long. 13 lin.

Hab. St. Catharine's (Brazil).

The male rather narrow, pitchy-brown above, body beneath, antennæ, and legs paler; prothorax more than twice as broad as long, closely and coarsely punctured, its posterior angles acute; scutellum small, triangular; elytra much broader than the prothorax, closely punctured; tarsi, especially the posterior, linear. The female is much broader, more depressed, reddish chestnut, the head nearly as broad as the prothorax, which is nearly as broad as the base of the elytra, and finely and somewhat sparsely punctured; elytra not closely punctured, each having, as in the male, a slightly-raised line not extending to the apex, and covering the abdomen only to the middle of the penultimate segment.

Explanation of Plate XIV.

Fig. 1. *Antigenes funebris.*
2. *Grynex lineatus.*
3. *Eecrisis abdominalis;* 3 *a*, side view of the head.
4. *Icariotis scapularis;* 4 *a*, ditto; 4 *b*, penultimate and claw-joint of anterior tarsus.
5. *Sparna macilenta.*
6. *Syennesis dispar* (♂), ditto.
7. ,, ,, (♀).
8. *Ochrasius stictieus.*
9. *Apheledes velutinus.*
10. *Erygalus polyspilus.*

XV. *Notes in 1887 upon lepidopterous larvæ, &c., including a complete account of the life-history of the larvæ of* Sphinx convolvuli *and* Aglia tau. By EDWARD B. POULTON, M.A., F.L.S., F.G.S., F.Z.S., of Jesus and Keble Colleges, Oxford.

[Read October 3rd, 1888.]

PLATES XV., XVI., & XVII.

CONTENTS.

1. THE ONTOGENY OF SPHINX CONVOLVULI.—Ever since the summer of 1884, when I had the pleasure of working out the ontogeny of *Sphinx ligustri*, I have been extremely anxious to obtain the fertile ova of two of our British *Sphingidæ*, viz., those of *Sphinx convolvuli* and *Acherontia atropos.* Through the great kindness of my friend and former pupil Mr. E. D. Y. Podo, of Slade, Ivybridge, who has helped me with material on many previous occasions, I have been able to work out the

ontogeny of the first-named species in the most satisfactory manner.

Mr. Pode captured a female *S. convolvuli*, flying over geranium in the garden at Slade, in the evening of Aug. 26th, 1887. Having previously obtained specimens in the same locality, and knowing my wish to work out the life-history, Mr. Pode placed the living female in a large box, in the hope of obtaining eggs. On the evening of Aug. 27th two eggs were laid, which were preserved by Mr. Pode: on the 29th, however, eighteen eggs were laid upon the paper bottom of the box, near together, but not in contact, being scattered over an area 18 mm. long by 10 mm. wide. These eighteen were sent to me, and constituted the material upon which this part of the paper was written. After this date the moth did not lay any more eggs. The only reference to the early part of this ontogeny, in any previous work, is that contained in Mr. Buckler's account of the larvæ of *Sphingidæ* (Ray Society, 1886). Mr. Hellins there mentions (p. 109) two occasions on which fertile eggs were obtained, but in both cases the larvæ died in the first stage, without any notes of interest having been taken.

If the amount of care and work bestowed upon the details of this life-history should appear to any one to be excessive, and perhaps unnecessarily minute, I would point out, in extenuation, that I was dealing with a species which has never* been previously described, except in the first and the last stages, and which I may never have the opportunity of investigating again. The immense difficulty in obtaining fertile ova of this species caused me to work at the material so kindly provided by Mr. Pode as if it were a last and final opportunity.

Ovum.—The ova are of the colour and shape (when looked at from above) shown in Plate XV., fig. 1 × 9. This deep bluish green colour is very unlike the brighter yellower shade of all the ova of *Sphingidæ* with which I am acquainted. Mr. Hellins, however, describes the egg as "pale green" (*l.c.*). It is possible that Mr. Hellins only noted the colour when it had changed as a result of the development of the larvæ. The shape is also different from that of closely related species, being relatively broader. But the most peculiar point about the ovum is its extremely small

size, when considered in relation to that of the adult larva and the perfect insect. The two main axes of the ovum measure respectively 1·3 and 1·15 mm., while those of the closely-allied but much smaller *S. ligustri* measure 1·75 and 1·5 mm. (See Trans. Ent. Soc. Lond., 1885, p. 281). (I may here call attention to an absurd misprint in this description of the ovum of *S. ligustri*: on the 12th line from the bottom of the above-quoted page, the word *sexes* has been substituted for *axes*). Mr. Hellins also states that the ovum is not more than two-fifths of the size of that of *S. ligustri*.

Stage I.—Times of hatching.—The first larva emerged on the evening of Sept. 5th, the second on the morning of September 7th. On the 8th, examination with the lens showed that the larvæ were fully formed in the remaining ova, which appeared somewhat wrinkled. I was therefore afraid of the larvæ dying before hatching, and accordingly, in the evening, the ova were placed in a room with a fire, in order that the moderate warmth might hasten emergence. By the next morning (9th) eleven larvæ had emerged, and the remaining four appeared a few hours later, in the afternoon, thus making seventeen larvæ altogether. One of the eggs did not undergo development, but subsequently changed colour and dried up.

The length of time occupied in development within the ovum was therefore as follows:—

1 larva, 7 days.
1 " $8\frac{1}{2}$ "
11 larvæ, rather over 10 days.
4 " " under 11 days.
—
17

Hence the development is at about the same rate as that of *S. ligustri*, which occupied 8—10 days (Trans. Ent. Soc. Lond., 1885, pp. 281, 282). Mr. Hellins (*l. c.*) puts the time of development at "rather less than three weeks." This is probably a mistake.

Amount of egg-shell eaten.—The habits of the larvæ must vary excessively in this respect, as was also the case with *S. ligustri* (*l. c.*, p. 282). Of the 17 empty egg-shells, three had become detached from the paper (probably in the post). Of the remaining 14:—

5 exhibited apertures of a size to admit of emergence, but not larger.
1 had been nearly half devoured.
3 „ about three-fourths devoured.
5 „ entirely devoured, except for the small part of the under surface by which they were fixed to the paper.
—
14

The newly-hatched larva.—The body is very pale yellow, with a slight greenish tinge on the anterior part of some larvæ: the head is of a very pale, brownish yellow colour, and of rounded shape. Mr. Hellins describes the larvæ as "at first white," (*l. c.*). The caudal horn, which from the first is held very nearly upright, is quite pale and transparent immediately after leaving the egg, but it very soon darkens and becomes black. It is very surprising that the deep colouring-matter of the ova should produce so little effect upon these pale and colourless larvæ. This is entirely contrary to my experience with *Smerinthus ocellatus*, in which I have observed that darker ova produce larvæ of a deeper green, and *vice versâ*. (See 'Journal of Physiology,' vol. viii., 1887, containing "Proceedings of Physiological Society," pp. xxv and xxvi.).

The newly-hatched larva when extended is 3·75 mm. in length, and there is very little individual variation. The newly-hatched larvæ of *S. ligustri* were found (*l. c.*) to be 5·25 mm. in length. When placed upon the food-plant, the young larvæ almost invariably rested on the underside of the leaf, stretched along the mid-rib (as in other *Sphingidæ*). A more minute description is better deferred until later in the stage; and will equally apply to the newly-hatched larva, except for a few points which will be obvious on comparing these with the succeeding paragraphs.

The larva during Stage I.—Shortly after the first meal the larvæ became green, and by Sept. 12th they had acquired a glistening appearance quite unlike anything I have hitherto seen in *Sphingidæ*. On Sept. 13th microscopic examination of the two oldest larvæ shewed that the colour had extended to the blood, which was of a pale yellowish green colour in the claspers and other parts remote from the digestive tract. The lateral longitudinal tracheal vessel can be distinctly seen with a lens, upon each side of the transparent larva, and the dorsal vessel and Malpighian tubules are also plainly

visible. The dorsal vessel forms a very distinct feature throughout the stage. The fact that the green colour of the larvæ is at this stage *chiefly* dependent upon the contents of the digestive tract, was well seen on Sept. 14th, when a single one out of the fifteen younger larvæ was found at the end of a shoot, where it had been eating the young yellowish leaves. This larva was of a much paler green than all the others which had been eating the older darker leaves.

The caudal horn is not so long as in *S. ligustri:* it tapers very slightly from base to apex, and it is held so as to nearly make a right angle with the line of the back. During this stage it is characterized by a very slight curve, with the concavity directed anteriorly, conferring upon it a very unusual appearance; for the curve in the horn of other *Sphingidæ*, and in the two last stages of this species, is in the opposite direction. (For the general appearance of the horn see Plate XV., fig. 2, × 5·8). The bifidity of the horn varies *immensely*, and this is probably true of the younger stages of all other *Sphinx* larvæ, although they have not been examined with equal care. These extreme individual differences are to be expected because of the vestigial nature of the part in question. The larva hatched Sept. 7th possessed the most strongly marked fork: it is shown from the front in Plate XV., fig. 3, × 50. The terminal bristles are seen to be stout; and each ends in a very slight knob, while the rest of the horn (of which only the upper part is shown in detail in fig. 3), is clothed with thickly crowded minute short hairs, each springing from a tubercular base. The structure is thus *very* different from that of the two next stages in which the horn presents a thorny appearance, due to the presence of a much smaller number of far larger hairs and tubercles. (Compare figs. 3 and 4, with 9 and 16, Plate XV.). I am now able to state that the caudal horn of *S. ligustri*, in the first stage, is similar to that just described, and bears the same relation to the stages which immediately follow. One of the younger larvæ also possessed a deeply-notched horn, but not so pronounced as that represented in fig. 3. The ends of all the horns of other larvæ were much like that shown in fig. 4, × 50, some having a rather deeper notch. The dark colour of the horn

slightly suffuses the larval surface around the base of this structure.

The well-known tubercles and bristles are distinct from the very first, having the arrangement shown in fig. 2, × 5·8. Each abdominal segment, from the 1st to the 7th, bears five of these prominent structures upon each side, and there are a large number of them upon the indistinctly separated segments posterior to the 7th abdominal. The arrangement upon this part can be seen in figs. 2 and 6, and upon the thoracic segments in figs. 2 and 5. There are at first no other shagreen tubercles upon the larva, but at the end of the stage, just before the resting period, there is an indistinct appearance of these structures. A fairly high power only shows that the green larval surface is mottled with white, and does not support the view that tubercles are present. It is probable that the effect is due to the partially-formed shagreen dots of the next stage, showing through the transparent skin. The head is thinly covered with short hairs. (Figs. 2 and 5).

The subdorsal line is certainly absent at first, but there is no doubt about its appearance at the end of the stage. It is very difficult to see clearly because of the glistening larval surface, and its borders are very ill-defined. It is possible that this feature also belongs to the next stage and is only seen through the skin.

Knowing that these larvæ subsequently become brown, I was very interested to find that five of them (the first hatched, and four of the fifteen younger larvæ), possessed a well-marked brown area, bounded by tubercles bearing bristles, upon the dorsal surface of the prothorax (see fig. 5); another brown triangular area, similarly bounded, on the anal flap, and a brown quadrangular area on each side of the anus (fig. 6). The anal claspers were also brown. These marks were present through the whole stage: the posterior patches were of a much darker brown colour than that upon the prothorax. The tubercles and bristles were, of course, similarly arranged in the larvæ without the brown areas. The prothoracic area is, I feel sure, the homologue of the hard plate which occupies this position in wood-boring and burrowing larvæ, in Tortrices, &c. This plate is evidently a *very* ancient feature of the lepidopterous larva. Traces of it can, I believe, be found

almost universally at one or other of the larval stages. It will be again referred to in this ontogeny. These five larvæ were isolated in order to determine whether the differences would be increased in succeeding stages.

The mature larva is about 8·25 mm. in length when extended, although it can stretch to 8·6 mm. Their length was very uniform. In the resting period before ecdysis the larva is cylindrical in shape, long and narrow, with a very uniform diameter, but tapering *very slightly* and evenly, from the 8th abdominal segment to the anterior extremity. This appearance is especially well seen when the larva is somewhat contracted. The *Sphinx* attitude was never witnessed in this stage, but the larvæ stretch themselves along the mid-rib on the undersides of the leaves. The positions of all seventeen larvæ were noted several times in this stage: two or three exceptions were always observed, a small proportion of the larvæ being stretched along the stem of the plant or along a leaf-stalk, and *very occasionally* upon the upper side of a leaf. It is very probable that many of the exceptions and all of the latter kind, were caused by the frequent disturbance to which the larvæ were subjected. Although the greatest care was always observed, the frequent removal for examination must have produced some effect. On one occasion a larva fell during removal, but remained suspended by a thread. The use of silk did not, however, seem to be so common as in the young *S. ligustri*.

I now append some data in a tabular form, indicating the length of the stage, and the dates at which any changes occurred. It will be seen that the dates lead to the very remarkable fact that Stage I. is considerably longer in the larvæ which hatched first, thus tending towards an equalisation of the periods of development, from the time at which the eggs were laid. It is to be hoped that this interesting result will be tested upon other larvæ.

Aug. 29th, evening, 18 ova were laid.
Sept. 5th, evening, first larva hatched: 3·75 mm. long.
,, 7th, morning, second larva hatched: first larva 5·25 mm. long.
,, 9th, ,, 11 larvæ hatched.
,, ,, afternoon, 4 ,, ,,
,, 12th, first larva showing traces of approaching ecdysis. Indications of shagreen dots noticed in first and second larvæ.

Sept. 13th, first larva showing more distinct traces } Indications of subdorsal line and green colour of blood noticed in first and second larvæ.
,, ,, second ,, ,, traces of ecdysis }

,, 14th, first larva 8·25 mm. long when extended.

,, ,, length of the fifteen youngest larvæ from 7·75—8·25 mm., being about at the close of the stage: subdorsal can be made out.

,, 17th, the first larva has changed skin in morning, Stage I. = 11½ days; the second in afternoon, Stage I. = 10½ days. The youngest larvæ have now been preparing for ecdysis for some time: very uniformly of a length of 8·25 mm. when extended.

,, 18th,	9.30 a.m., 8	had changed skin. Stage I.=9 days.	
,, ,,	10.30 a.m., 1	,, ,, ,, ,, ,, ,,	
,, ,,	1.30 p.m., 2	,, ,, ,, ,, ,, 9½ ,,	
,, ,,	3.0 p.m., 1	,, ,, ...	Stage I. = 9 days.
,, ,,	10.0 p.m., 1	,, ,, ...	
,, 19th,	9.25 a.m., 2	,, ,, (probably some time)	Stage I.=9½ days (about).
	15		

Stage II.—Immediately after ecdysis the horn is colourless, but it deepens into black (except for the median zone) in the course of an hour or two, and this is also true of the dark patches and shades present on most of the larvæ. The head retains the rounded form, but loses it in subsequent stages.

This stage opened with a great surprise. I had fully expected that the five larvæ which exhibited dark marks in the last stage, would still continue to be the darkest varieties in this, and that the differences would even increase. To my great astonishment these five larvæ were *much lighter* than the others as a whole, so that the relations were completely reversed. It will be shown below that similar reversals occurred in the later stages.

The caudal horn is held as in the last stage, but it is now very nearly straight. It is still bifid, but the fork is much smaller and less conspicuous. Its surface is now thorny, from the presence of relatively few large tubercles which terminate in bristles: a section of its length nearer the tip than the base is now white and partially transparent. The general appearance of the structure, from the anterior side, is seen in Plate XV., fig. 9, × 24·5. The larva is still green and is covered with white shagreen dots, each terminating in a bristle exactly as in *Smerinthus* and *Sphinx ligustri* in this stage. The subdorsal is present, but is not so conspicuous as it becomes later in the stage. All other characters present at the

beginning of the stage varied greatly. The main tracheal trunk is quite visible through the whole of this stage, and the dorsal vessel still forms a very prominent dark-green median line.

On September 20th, when the average length of the seventeen larvæ was 10.5 mm., they were all carefully compared together, with the following results:—

Eleven of the larvæ without dark markings in Stage I.—Dark pigment (black in the extreme varieties, smoky in others) is now present in some of the larvæ, on the head, prothorax, thoracic legs, claspers, near the anus, and round the spiracles.

The four lightest larvæ had the dark pigment only slightly developed on the claspers, thoracic legs, (in one of them the claspers were free from dark pigment, and the thoracic legs comparatively pale), round the spiracles, and along the lower edge of the furrow running below each lateral margin of the anal flap: from this furrow the dark colour tended to spread downwards. There was also a *very slight* dusky shade over the region of the ocelli in two of these larvæ.

The remaining seven larvæ were much darker: in only one of them was the pigment on the head confined to the ocellar area. The darkening below the anal flap was strongly marked, and in a few of the darkest larvæ it extended on to the flap itself, although chiefly developed upon the edges of the latter. The previously described dark marking on the dorsal surface of the prothorax was distinct in one of the darkest larvæ and just indicated in one or two others. One of these larvæ is represented in Plate XV., fig. 7, $\times$ 5·8.

Six of the larvæ, of which five possessed the dark markings in Stage I.—These larvæ were much lighter than those described above. Only one possessed the dark shade (and this not strongly marked) on the side of the head, other than on the ocellar area: only one (not the same larva) shewed some slight indications of the prothoracic darkness which was marked in five of these larvæ in the last stage. There was a slight cloud over the ocellar area of four larvæ. The lightest of all the seventeen larvæ was included in this division: in it the dark colour was absent from the region of the anus and the claspers, and was very slight on the thoracic legs and round the spiracles. All the larvæ except this, and one from the

former division, had the dark shade more or less marked on the claspers.

The transparent zone on the caudal horn was especially distinct in this division and in the lightest larvæ of the other division.

The larvæ were now (Sept. 20th) re-arranged in two new divisions, according to the presence of dark pigment in this stage. There was an obvious contrast between the seven darkest larvæ of the first division and all the others: the new division of ten light larvæ was of course constituted by adding the four palest of the old first division to the old second division.

On September 21st I observed the presence of a row of brown spots on each side of the larva in the light division, which possessed traces of the prothoracic darkening. There was a spot on each of the abdominal segments, 1—7 (inclusive), situated just above the spiracle and below the lower margin of the subdorsal line. This marking could not have belonged to the next stage, as I thought at first, for the larva was still feeding, and continued to feed for two days.

On Sept. 22nd the subdorsal line became much more distinct on all the largest larvæ. It had also become very broad by extending upwards, being thus gradually transitional into the broad green dorsal band. Its lower margin remaining sharply defined, it follows that the ground colour of the body is somewhat sharply divided into a dorsal and ventral shade. The brown-spotted larva was carefully examined: it had a dusky tinge in the region of the ocelli, from which a faint cloud extended up the side of the head: there was a fair amount of dark pigment on the thoracic legs, which became red towards their extremities, on the claspers, and below, and (by this time) upon the anal flap. The seventh white stripe which terminates upwards at the base of the caudal horn could now be just made out in its upper part, in this and most of the other larvæ. This stripe was always the first to become conspicuous in *S. ligustri* and in *Smerinthus*. An excessively faint brown border to this stripe was continued downwards and forwards from the seventh brown spot. Similar indistinct borders extended from the 4th, 5th, and 6th spots, but the stripes themselves could not be seen. The homology between these spots and those described upon

many *Smerinthus* larvæ is obvious, and hence the fact that the brown borders are certainly connected with the spots, becomes of great importance. There will be far more evidence of this in the next stage. The faintest trace of brown spots could now be seen upon another larva of the same division, but they were so slight that their presence would not have been noticed except for the clue afforded by the former larva. The seventh spot was only represented by a darkening of the green ground colour. The seven dark larvæ were also carefully examined, and traces of one or two brown spots were perhaps present upon two of them, but I could not feel sure of this. The upper part of the seventh stripe was present, probably upon all of them.

On Sept. 23rd the seven dark larvæ were again minutely examined, and it was noticed that the upward-extending part of the subdorsal line,—in mature larvæ which had not yet entered the resting-stage before ecdysis,—was distinctly divided into oblique white stripes, of which each pair tended to meet and form a V, with the backward-directed apex interrupted by the dorsal line, due to the underlying dorsal vessel. In some larvæ five distinct, oblique, white stripes could also be made out below the subdorsal, and two more very faint ones in the most strongly marked individuals. The continuity between the upper and lower sections of an oblique line, above and below the subdorsal, was obvious in two or three of the segments.

Very slight traces of brown spots,—often a mere darkening of the ground colour, with sometimes the faintest brownish tinge,—could now be made out on most of these larvæ. Each spot was always placed just below the lower edge of the subdorsal, in such a position as to form the upper part of a dark border to the oblique white stripe, whether the stripe itself was present or not.

The ten light larvæ were also examined at the same time. The brown-spotted larva was now in the resting-period. The dark pigment upon it had not undergone any further change since the last description of the larva on Sept. 22nd. There were now distinct traces of brown borders extending from the three posterior spots, and very slight traces extending from the four others. No stripes could be seen except the upper part of the last, which was distinct. This larva in which the spots

and associated borders were developed to a far greater extent than in any of the others, was now removed to a separate cylinder, in order to test its relation to the other larvæ in the next stage. This larva is represented in outline on Plate XV., fig. 8, × 5·8. The shagreen tubercles are omitted, except in profile: all the dark marks represent pigment. The dark mark between the 2nd and 3rd thoracic segments probably belongs to the next stage, and is seen through the transparent cuticle.

The oblique white lines above the subdorsal were less distinct in these light larvæ, but they could be made out by comparison with the more decided appearances in the other set. They were best seen by looking at the larvæ with the naked eye and from a little distance.

The *Sphinx*-like attitude is rarely, if ever, assumed in either of the two first stages: the larvæ still stretched themselves along the midrib on the under sides of leaves, but especially along the leaf-stalks and stems of the food-plant. When disturbed they wriggled from side to side, and often fell from the food-plant. I have never before met with larvæ which manifested so little disposition to wander. On Sept. 23rd I noted that no larva had ever been found off the food-plant, and this in spite of continual disturbance during examination.

The larvæ were fond of eating the leaf-stalks and stems as well as the leaves of the food-plant. Towards the end of the stage, as the skin became stretched, the larvæ began to assume a somewhat glistening appearance. During the resting-period before ecdysis the ground colour became lighter, and of a more transparent and yellowish green: the change is almost certainly due to the comparative absence of food from the digestive tract at this time.

The mature larvæ were about 14 mm. in length when moderately extended, but the largest could stretch to 15 or even 16 mm. During the resting-period the length was very uniformly 14 mm.

I now add data from which the length of the stage and of the resting-period can be calculated. The average length of the stage appears to be about eight days, and the variations are not more than one day on each side of this.

	The lot of 10 pale larvæ.	The lot of 7 dark larvæ.
Sept. 23rd.	9.30 a.m. 4 larvæ had entered resting-period before changing second skin (including the brown-spotted one); the rest practically mature in stage.	10.30 a.m. 2 larvæ had entered resting-period before changing second skin; the rest practically mature in stage.
	1.20 p.m. 1 more had entered resting-period.	5.40 p.m. 2 more had entered resting-period.
Sept. 24th.	9.5 a.m. 3 more had entered resting-period; 2 feeding still.	10.0 a.m. 3 more had entered resting-period.
	6.15 p.m. 1 larva had changed skin.	
	9.10 p.m. 1 more larva had changed skin (this was the brown-spotted one).	
Sept. 25th.	9.0 a.m. 1 more larva had changed skin.	9.0 a.m. All in resting-period.
	1.10 p.m. 1 more larva had changed skin.	3.30 p.m. 1 larva had changed second skin.
	5.0 p.m. 1 more larva had changed skin.	5.0 p.m. 1 larva had changed second skin.
Sept. 26th.	9.0 a.m. 2 more larvæ had changed skin.	9.0 a.m. 3 larvæ had changed second skin.
	10.45 p.m. 2 more larvæ had changed skin.	11.40 a.m. 1 larva had changed second skin.
Sept. 27th.	2.30 p.m. 1 more larva had changed skin.	3.15 p.m. 1 larva had changed second skin.

Stage III.—All the individuals were healthy at the beginning of this stage except the darkest of those described in the last stage, as the division of 10 pale larvæ. This larva died Sept. 27th. On the 29th all the larvæ were carefully compared and described. The larvæ remained shagreened as in *Smerinthus* and *Sphinx ligustri*, although the character is not represented in the figures.

THE TEN PALE LARVÆ OF STAGE II.—Three of these larvæ were bluish green, like the well-known tint of *S. ocellatus*, although not so bluish as the extreme varieties of the latter. One was bluish green inclining towards intermediate. In describing these larvæ the ones with the smallest amount of the dark markings are, with one exception (the 10th larva), taken first.

(1). The least-marked larva possessed a somewhat lighter horn than that shown in Plate XV., fig. 10, × 3: in other respects it was similar, with the yellowish transparent zone near the tip, and the light pinkish area at the side of the base. Red spots, like those of *Smerinthus* larvæ

were present; upon the 7th abdominal segment the spot was only represented by darkened ground colour; upon the 6th abdominal it also possessed a very faint reddish tinge, which was rather more distinct upon the spots on the other abdominal segments, although the red area was always extremely small. There was a faint dark cloud on the anal flap, and a dark mark below its lateral margin. Each of the four anterior claspers possessed a dark semilunar mark. The thoracic legs were red, becoming black at the base, and the ridge to which each pair of these legs is attached, was also dark. The first and the two last spiracles were brown, the others very dark brown, producing the effect of black. There were two slight smoky patches, the one anterior and the other posterior to each of the spiracles; especially faint in the case of the prothoracic, and especially pronounced in the case of the 1st abdominal spiracle. Upon the head the ocellar area was dark and an almost imperceptible tinge spread upwards from this area over the side of the head. The subdorsal line was faint except in its anterior part; the oblique white stripes and their borders were also faint, but distinctly visible. No traces of an 8th stripe could be made out, as in the early stages of *Smerinthus* and *S. ligustri*. A faint dark tinge was present between the 2nd and 3rd thoracic segments at the spiracular level, and this, spreading outwards, formed a somewhat distinct patch on each side of the larva. This patch was separated from the prothoracic spiracle in front, and the 1st abdominal spiracle behind, by a distance which corresponded to that between the abdominal spiracles, and thus the existence of an additional spiracular patch, making a complete series with equal intervals, was suggested, as in the case of certain varieties of *Smerinthus populi*. (See Trans. Ent. Soc. Lond., 1885, p. 305).

The ground colour was yellowish green beneath, light bluish green above, the demarcation being sharp, and taking place at the subdorsal level, as in many larvæ of *Smerinthus ocellatus*. A median dorsal line, somewhat darker than the adjacent ground colour, was present.

(2). The second larva was rather bluer beneath: the white stripes and their borders of dark ground colour were *very* distinct, as was the whole length of the subdorsal line. The red spots were very distinct but very

small, especially on the 7th abdominal segment The anal flap was without the dark cloud, and the dark mark below it and on each of the four anterior claspers, was very faint. The thoracic legs were paler than in the last individual. Upon the head there was only a faint cloud on the ocellar area. The lateral mark between the 2nd and 3rd thoracic segments was present; the patches on each side of the spiracles were fainter and very slight, and they were entirely absent in the case of the 1st spiracle. On the other hand the 6th abdominal spiracle was dark-brown, almost black.

(3). The appearance of the 3rd larva is represented in Plate XV., fig. 10, × 3. There was a slight dark cloud upon the border to each oblique white stripe; it appears upon the border just as it enters the posterior of the two segments in which its course lies, and just above the level of the subdorsal line. The stripes and borders were less distinct than in the larva last described, but they are represented more distinctly in the figure, so that in this respect the appearance of the 2nd larva is given, rather than that of the 3rd. The red spots were much larger than in the two larvæ described above. The last spot was much fainter than the others. The head was bright yellowish green, as in the other bluish larvæ; and as in the young bluish or whitish larvæ of *Smerinthus ocellatus*. The dim lateral shade was developed to the extent shown in the figure. The spiracles were like those of the 2nd larva, but the patches were more distinct. The distinction between patch and spiracle could not be indicated on a drawing of the size of the figure. The smoky patch was very faint in the case of the prothoracic spiracle, but it tended to pass backwards, so as to nearly fuse with the patch between the 2nd and 3rd thoracic segments. The median dorsal line was present, as in all these larvæ. The ground colour was not quite such a whitish blue-green as in the last individual.

The extremely Smerinthine appearance of these three larvæ is well shown in fig. 10.

(4). The fourth larva was less decidedly bluish green, and tended somewhat towards an intermediate variety. The horn was very black, and the transparent zone was only slightly marked. The red spots were rather larger than in the larva last described, but they were otherwise similar. There was only a slight dark shade upon the

anal flap, but below it there was much of the dark colour (more than in any of the three larvæ hitherto described), and a dark shade appeared, for the first time, at a still lower level, upon the last clasper. The patches around the spiracles were larger and darker, and the three lightest spiracles (1st and the two last) were also darker. The claspers were blacker, and a dark shade spread upwards from the semilunar mark. The dark spiracular line extending backwards from the first spiracle was more marked than in fig. 10. The thoracic legs were blacker and less red. The lateral marks on the head were very black, and there were rather faint lines in front of and parallel with the former. These marks were more distinctly shown in other darker larvæ (see figs. 11, 12, 13, and 15). The subdorsal line, oblique stripes and their borders were very much as in the 3rd larva, except that there was a distinct, although faint, dark cloud upon the borders, *below* the red spots; this character is plainly shown in another larva represented in fig. 11.

(5). The fifth larva was, like the fourth, a long way on the bluish side of an intermediate variety. The horn was very black; the light zone being small but bright yellow in colour. The spiracles were black, except the first and last, which were dark brown; the patches surrounding them all were large but not very dark. The red spots were large, becoming somewhat larger anteriorly. The borders to the stripes, above and behind the spots, were very faintly reddish, especially in the posterior of the two segments crossed by each border, and also in the anterior part of the anterior segment. (This arrangement is shown in a far more pronounced form in fig. 11). This character was less distinct in the last two stripes. The other parts of the borders were distinct and of a dark green colour. The spiracular line upon the thoracic segments, and the mark between the 2nd and 3rd of these, were distinct, although not very black. The broad lateral line on the head was dark and distinct, and traces of the anterior line were also present. The subdorsal line was very indistinct except anteriorly; the stripes were fairly distinct, especially the last. The shade on the anal flap was faint and of small extent, but large and dark below it. The thoracic legs were very dark above and red below, like

those of the larva last described. There was a faint subspiracular cloud, corresponding to that which was more distinct in other larvæ (figs. 11, 12, 13). There was a tendency in this and all the other larvæ, towards the fusion of the posterior parts of the dark borders with the dark dorsal line.

(6). The sixth larva was very similar to the last, only rather darker throughout. The traces of red borders to the stripes were somewhat more distinct. The transparent zone was very small, although bright yellow.

(7). The seventh larva was a distinct yellowish green variety. The spots were still reddish, although darker in colour than in previous larvæ; the dark parts of the borders were also of a dark reddish colour. The fusion between the dorsal line and posterior parts of the borders, had now caused the appearance of a broad dark green dorsal band. The stripes were distinct and of a yellowish white colour. The zone on the horn was slight and dim. The spiracles were all black except the last, which was nearly so. The last red spot was small and indistinct, and the last but one was also smaller than the others. The anterior line on the head was distinct, as well as the lateral band. There was no trace of an anterior extension of the upper part of the dark borders along the upper margin of the subdorsal line, as in other larvæ to be described below (see figs. 11, 12, 13). In all the points not specially alluded to, this larva was about as dark as the one last described.

(8). The eighth larva was also distinctly yellowish green, and its appearance is indicated in fig. 12, (× 3). It was *much* darker than the last and the spots were black and not red. The amount and distribution of the dark markings is sufficiently indicated in the figure. Although so different from the larvæ hitherto described, some of the varieties of the next division of larvæ, of which one is represented in fig. 11, form a very perfect transition from this to the lighter larvæ. The very different and darker ground colour of the area above the subdorsal, is very striking.

(9). The ninth larva was the darkest obtained except one (the 7th of the next division): it was the larva which died Sept. 27th.

(10). The tenth larva was the one which was separated in the 2nd stage, because of the especial development of

brown spots (see fig. 8). Under these circumstances it might have been expected that the larva would be among the dark varieties of the succeeding stage; but, as in other cases, the reverse took place.

This larva was examined and compared Sept. 29th; it was a distinct bluish green variety, ranking with the 1st, 2nd, and 3rd larvæ already described, The red spots were distinct, becoming larger and more distinct anteriorly; the last was far the smallest, and the last but one intermediate between this and the others. The stripes and borders were very distinct and *Smerinthus*-like, as in the 2nd larva. The subdorsal line was very distinct anteriorly. The larva was therefore a very light variety, and it would rank between the 2nd and 3rd of those described.

On Oct. 2nd it was again examined. There was no dark shade on the head, very little on the claspers; the thoracic legs and the horn were as in the other light varieties. There was a very slight shade on the anal claspers, and hardly any on the anal flap. The whole appearance was extremely Smerinthine. The stripes were of a bright yellowish green colour (somewhat deep in tint as compared with other larvæ).

THE SEVEN DARK LARVÆ OF STAGE II.—Upon the whole these larvæ were somewhat darker than the ten larvæ just described, and hence the effects witnessed in the last stage have, in this case, passed on into the succeeding stage; but it will be seen that the differences are very small.

As before, the bluish, lighter larvæ will be described first. The larvæ were compared Oct. 2nd.

(1). A bluish green larva, about equal to the lighter of those described. The shade upon the head was almost confined to the ocellar area, an almost imperceptible cloud extending upwards from the latter. The increase in the size of the red spots anteriorly was well seen, the last spot being very minute. The first and two last spiracles were light brown, and the surrounding patches were in all cases very small. The amount of dark colouring elsewhere was very slight, although distinctly traceable in the usual positions. There was hardly any dark pigment between the 1st and 2nd spiracles.

(2) and (3). These two larvæ, although bluish green,

would rank with the 5th and 6th of the previous divisions, for there were distinct red marks upon the borders to the stripes, below the red spots, in both larvæ, and also above the spots in the 3rd larva. The 2nd larva had a slight transparent zone in the horn, and a very dark head; while the 3rd had the zone even less marked, but the head lighter. Both larvæ were fairly dark around the anus, but the flap of the 3rd was much the darker. The stripes and dark green borders were quite distinct in the 2nd, fairly so in the 3rd larva.

(4). Then followed a larva with a ground colour of an intermediate tint. (This larva is represented in fig. 11, × 3). The condition of the borders made this larva decidedly darker, for the dark-red shade was not only present upon the borders above and below the red spots; but in the former locality a dark smoky shade extended from the central red mark, stretching along the upper edge of the subdorsal line, and forming a very conspicuous feature. In addition to this, there was a highly conspicuous oblique dark patch above the subdorsal, upon each of the 2nd and 3rd thoracic segments, and upon the 1st abdominal (see fig.).

The degree of development of the dark markings in other parts of this larva is shown in fig. 11. This larva would be quite as dark as the 7th of the previous division, but it was not of the same distinct yellowish green colour. The elongation of the red spots along the borders (see fig. 11) is a very interesting feature, indicating the relation of these characters to the coloured borders of *Sphingidæ*. It should also be noted that the transparent zone in the horn was well-marked.

(5). This larva was very similar and an intermediate variety, although with a slightly yellower tint of ground colour.

(6). This larva was also an intermediate variety. In darkness it would be intermediate between the 7th and 8th of the other division. These last three larvæ were very similar, although their relative darkness is expressed by their order.

(7). This was the darkest of all the larvæ in the 3rd stage. It was a yellowish green larva, and is represented in fig. 13, × 3, and also in fig. 14, × 5·25. The latter figure being larger, it has been possible to introduce

the shagreen dots, which were omitted from all the other figures of this stage. The distribution and amount of the dark markings is sufficiently indicated in the figures. The easy transition from the degree of darkness indicated in fig. 12 (the 8th larva of the last division), to that shown in fig. 13 is very clear. The larger scale of fig. 14 has permitted the representation of two of the chief tubercles, which are quite distinct upon most of the segments. These have the appearance of black points, one above and one below each spiracle except the last, in which one is above and one behind. The hairs which spring from them are long. The shagreen tubercles are generally darker on the dark parts of the larva, *e.g.* the horn.

The head is very black, and its green ground colour has become dark, while the black markings have extended greatly. Its appearance from the front is seen in fig. 15, × 9. The area above the subdorsal is now almost completely black, the green ground colour being chiefly traceable along the median line.

Although the markings have the effect of black at a little distance, and are thus represented in the figures, a careful examination in a strong light on Sept. 29th, showed that all the dark markings upon the borders and above the subdorsal are of a purplish brown colour, but of so dark a shade that they appeared to be black. On Oct. 2nd, when the larva was in the resting-period before ecdysis, this purplish tint had become more distinct, and it could now be recognised everywhere except on the darkest places,—*viz.*, the horn, upon and below the anal flap, and upon the head. At this time there was also a prothoracic dorsal plate distinctly demarcated from the surrounding surface, like that described in Stage I., and shown in fig. 5. This structure also became especially distinct in the resting-period of the next stage. In the 3rd stage the plate was traversed by the subdorsal line, and hence became mottled with white upon each side, while the plate regained its black colour below the line. This appearance only became distinct during the resting-period, and is not shown in figs. 13 and 14, which were drawn at an earlier period.

The apparent black marks of the other larvæ could also be resolved into purplish brown tints in a strong light, especially towards the end of this stage.

The caudal horn is still thorny and distinctly bifid, although not so deeply or widely notched as in the last stage. The notch was uniformly present in the larvæ. The appearance of the horn of the 3rd stage, as seen from the front, is shown in fig. 16, × 14·5. The horn figured was one in which the transparent zone was well-marked; it is quite straight, and held at the angle shown in figs. 10—13.

The results of this comparison of the darkness and the shades of ground colour in this stage may be expressed in the following tabular form. The intervals between the larvæ indicate breaks in the transitional series:—

	Palest and bluest.	Inter-mediate.	Yellowest and darkest.
The 10 pale larvæ of the last stage.	{1, 2, 10} 3* — 4 —	5 6	— — 7 — 8* — 9 — (dead)
The 7 dark larvæ of the last stage.	1 — — — —	2 3	— 4* 5 6 — — — 7*
	I.	II.	III.

The larvæ with asterisks affixed were those represented in figs. 10, 11, 12, 13 (and 14). The divisions I., II., III. indicate the new arrangement, which was adopted on Oct. 2nd, after the comparison of colours.

If the larvæ were arranged with reference to the shade of ground colour alone, the following series would be obtained (omitting the 9th in the division of 10 pale larvæ):—

	Bluish green.	Intermediate.	Yellowish green.
The 10 pale larvæ ..	{1, 2, 3, 10} — 4 {5, 6}	— —	{7, 8}
The 7 dark larvæ.....	1 {2, 3} — —	4 {5, 6}	7

There are several points of extreme interest in this 3rd stage. The resemblances to *Smerinthus* larvæ are very marked, in the variability of the ground colour, in the variable development of red spots, and the relations of the latter to the borders of the stripes. The association

of a bluish green ground colour with the absence of pigment and a general Smerinthine appearance, is very striking, when compared with the dark markings and greater peculiarity of the yellowish larvæ. Nevertheless, there is a very gradual transition from the one type to the other, and this can be clearly seen in the series of four larvæ represented in figs. 10—13, although there were other larvæ intermediate between some of these (see the above table).

The stages of this transition probably represent the steps by which the dark variety has arisen from the green one. These stages are:—

1. A green *Smerinthus*-like larva with a red spot on the border to each stripe.
2. The increase in the dark part of the borders both in size and in depth of tint. The red spots elongate along the border, and at the same time distinct dark reddish patches appear above and below the elongating spots. Dark patches and bands appear and increase elsewhere.
3. The borders become still darker, and their upper part tends to spread anteriorly along the upper edge of the subdorsal, thus shutting off a band of dorsal ground colour.
4. The ground colour thus shut off first becomes much darker than the rest by a deepening in the tint of the ground colour itself, finally nearly black, from the gradual intrusion of the black borders of the band.

The further continuation of this process of darkening will be seen in the following stage. It must be remembered that the purplish-brown colour of the markings connected with the borders, together with the elongation of the red spots and the red colour of the additional dark marks on the borders, seems to clearly support Prof. Weismann's conclusions that the red spots are connected with the coloured borders to the stripes. These facts also serve to connect together *Sphinx* and *Smerinthus* in a most interesting manner.

Data as to the third change of skin and the lengths of the larvæ are given below:—

CLASSIFICATION AS IN STAGE II.

Sept. 30th. 1 of the palest of the lot of 10 larvæ has entered the resting-period, and one or two others are mature.

Oct. 1st, evening. 3 of this division have now entered resting-period.

„ 2nd, 9.15 a.m. 6 of this division have now entered resting-period. The brown-spotted larva of Stage II. (No. 10) is mature, but not yet in the resting-period.

„ „ 11.15 a.m. The darkest of the lot of 7 larvæ has entered the resting-period.

CLASSIFICATION OF STAGE III. ADOPTED OCT. 2ND.

Dates.	I. The 6 lightest and bluest larvæ.	II. The 4 intermediate larvæ.	III. The 6 darkest and yellowest larvæ.
Oct. 2nd	....	3.30 p.m. All 4 in resting-period, and measuring 24·5, 24·5, and 22 mm. in length (the 4th not in appropriate attitude).	
„ „	7.40 p.m. 3 in resting-period; 1, 25·0 mm. long, and 2 about 22·0 and 23·0 mm., but not stretched. The larva which is nearest to ecdysis has become quite dark beneath the old skin.	....	7.35 p.m. 2 in resting-period; both measuring about 23·6 mm.
„ „	8.30 p.m. This larva had now changed its skin, and was quite dark. It had been about the palest of the lot of 10, viz., No. (2).		
Oct. 3rd	9.30 a.m. Another changed skin, and also dark. The 4 others all in resting-period, and measuring 23·25, 23·5, 23·6 and 25·0 mm. in length.	9.35 a.m. Still in resting-period, and measuring 22·5, 24·0, 24·25 and 24·5 mm. in length.	9.40 a.m. 4 in resting-period, and measuring 23·0, 23·3, 25·0 and 25·4 mm. in length.
„ „	5.30 p.m. Another just changed skin: not dark like the others.		
Oct. 4th	....	12.20 noon. 1 has just changed skin, and another is now changing.	11.50 a.m. 1 larva has just changed skin, and the darkest variety is now changing; the process had been completed when examined half an hour later; both became dark varieties.

Dates.	I. The 6 lightest and bluest larvæ.	II. The 4 intermediate larvæ.	III. The 6 darkest and yellowest larvæ.
Oct. 4th	....	10.20 p.m. 1 larva has darkened beneath the old skin, and is therefore almost ready for ecdysis.	10.15 p.m. 1 larva has just changed skin: a dark variety.
Oct. 5th	11.50 a.m. 1 has just changed skin.	9 a.m. All 4 larvæ have changed their skins some little time: the last to change is a light variety.	9 a.m. No further change.
Oct. 7th	6.55 p.m. The last two larvæ have changed their skins some time, and are both dark varieties.	....	6.35 p.m. 2 more had changed skin, 1 some time and dark, 1 recently and light, although the darkest of the 3 light varieties obtained. The 6th larva did not change its skin until Oct. 12.

On the evening of Oct. 5th many of these larvæ, at the beginning of Stage IV., including examples of all the varieties, and the one from division III., which had not yet entered the resting-period, were shown at the meeting of the Entomological Society of London.

There were some indications that the slow growth of this last larva, which fell so far behind the others, was due to weakness and ill-health, which indeed is the rule in larvæ. On one occasion (Oct. 4th) I saw that it had some difficulty in getting rid of the excreta during defæcation; it turned round and pulled the mass off with its mandibles.

It is interesting to note that the larvæ darken to a considerable extent just *before* changing the skin; in certain other cases (*e.g.* dark lepidopterous pupæ, the black head of the larval *Crœsus septentrionalis*, &c.), the dark parts are white or pale yellow, until after exposure to the air for some few hours. Certain observations made at the beginning of the last stage render it probable that the air gains access to the new cuticle shortly before ecdysis. The old cuticle is probably at this time dry, and not sufficiently continuous or dense to exclude the presence of air.

Stage IV.—On Oct. 8th, all the larvæ were carefully

compared, except the single one in Division III., which was still in the 3rd stage.

I. *The six lightest and bluest larvæ of the 3rd stage.*—Of these larvæ three were large (about 38 mm. long), and three small (about 30 mm.). They are arranged in the order of relative darkness, the lightest larva being described first.

(1). The lightest and greenest larva was one of the small ones mentioned above; it was painted Oct. 10th, and is represented in Plate XVI., fig. 1, × 2. The arrangement of the dark markings and relation to the green ground colour is sufficiently indicated in the figure. This was the lightest of all the larvæ in the 4th stage, and it is seen to be transitional from the darker larvæ of the last stage, while it is also connected with the darker larvæ of this stage by a very complete series of gradations, the chief of which are indicated in figs. 1, 2, 3, 4, 5, of Plate XVI. The larvæ were still covered with shagreen tubercles as in *Smerinthus* and *Sphinx ligustri;* these are not shown in the figures.

(2). All the five remaining larvæ were dark varieties; the least dark of these was (2), one of the small larvæ, which possessed distinct stripes and borders, together with faint traces of the green ground colour, while the subdorsal became distinct in its anterior part. This larva is represented in Plate XVI., fig. 3, × 2, and it is seen to afford a beautiful transition towards the darker larvæ.

(3). One of the larger larvæ possessed a very distinct subdorsal line, and a fairly distinct subspiracular, both these lines remaining light and contrasting strongly with the dark larval surface. The red spots could be made out plainly, but they were very dark, almost black.

(4). Another of the large larvæ was similar, only the two longitudinal lines (subdorsal and subspiracular) were not so bright and distinct.

(5). The third of the larger larvæ, in which the stripes and red spots were so dark that they could hardly be distinguished from the general surface of the larva. The two longitudinal lines were distinct, and of a bright yellow colour, as in Plate XVI., fig. 4, which represents one of the larvæ of Division III.

(6). The third of the smaller larvæ was much like the last only still darker, although the stripes were more distinct.

The difference between the 6th and the other larvæ decreased, and that between the 2nd and the others increased subsequently, for the dark colour becomes rather less deep during growth. The real line of demarcation was, however, between the 1st larva and all the rest; this great difference dwarfed all the minor differences between the latter.

The horn in this stage is slightly curved, and possesses the shape shown in Plate XVI., figs. 1—5. It will be noticed that the curve is now the reverse of that seen in the 1st stage. The surface is shining, although still rough, with comparatively small tubercles, which represent the far larger thorns present in the two previous stages. The colour is black, with a dark reddish brown patch on each side of the base, especially bright in the green variety (1), and hardly present at all in the case of (4) and (5). There was a *very* faint trace of the light transparent zone on the horns of (1), (3), and (4). The tip was slightly but distinctly bifid in all except (4) and (5).

The spiracles were bright orange and extremely conspicuous in all the larvæ.

II. *The four intermediate larvæ of the 3rd stage.*— These larvæ were of very uniform size on Oct. 8th, being about 30 mm. long.

(1). This larva was a green variety, but not so bright or with so much of the green colour as (1) of the previous division. There was rather less green on the head and much less along the median dorsal line. The green was duller and less yellowish in tint. The dark borders were much wider, and were of considerable breadth at the point where they became continuous with the black dorsal band; whereas these two dark markings were almost discontinuous in (1) of the previous division, thus nearly allowing the subdorsal line to pass between them. The transparent zone on the horn was slightly marked; there was hardly any of the reddish brown colour at the base. This larva was carefully re-examined on Oct. 11th, when nearly mature in this stage, and was again compared with the lightest of the previous lot (shewn in Plate XVI., fig. 1); the larva formed a beautiful but gradual transition from the latter in the direction of the darker larvæ. All the points in the comparison made above continued to hold at this later date. It was also

noted that the dark spiracular band on the thoracic segments was wider and that the horn was blacker. The oblique stripes were white.

(2). A dark variety about equal to (4) of the previous lot. An exact comparison was very difficult, especially because of the change of colour during growth, and also because the darkness varied in different parts of the larvæ, so that extreme darkness in one part might be compensated by unusual lightness in another. Thus this larva retained the traces of the green ground colour as in (2) of Division I. (fig. 3). Nevertheless the differences between the dark larvæ were insignificant compared to the differences between them and the green larva. There was no trace of the transparent zone on the horn.

(3). A dark variety about equal to (5) of the previous division. The ground colour was dark, but the two longitudinal stripes were very distinct, and the transparent yellow zone on the horn very conspicuous; but there was hardly any reddish brown colour at the side of the base.

(4). This larva was darker than any of the previous division. The transparent zone on the horn was slightly marked. The larva is represented in Plate XVI., fig. 5.

There were faint traces of a bifid termination to all the horns except that of (1) which was somewhat distorted.

III. *The six darkest larvæ of the 3rd stage.*—Five of these larvæ were compared Oct. 8th, the 6th being still in the previous stage. The lengths of the larvæ are given below.

(1). The lightest larva was an extremely interesting green variety, transitional from the 1st of the last division towards the dark varieties. It is represented in Plate XVI., fig. 2 × 2. Although much darker than either of the other two green varieties, there was nevertheless a large amount of green colour spreading from the stripes. The reddish brown patch at the base of the horn was very distinct in this and the other four larvæ of this division. This larva was about 27 mm. in length.

(2). This larva was about equal to the 5th of Division I. Length 36 mm.

(3) and (4). These larvæ were *very* dark, but the two longitudinal stripes were very distinct and of a bright yellow colour. The larvæ would be classified with (6) in

Division I., and their appearance is represented in Plate XVI., fig. 4. One of these larvæ exhibited no trace of a bifid extremity to the horn, which was present in all the others of this division. Length of both larvæ 36 mm.

(5). This larva was equally dark and with the longitudinal stripes less strongly pronounced. It would be classified with the darkest larva—(4)—of Division II., and may be represented by the figure of the latter larva (fig. 5). The yellow transparent zone on the horn was very distinct in this larva and (1), *very* slight in one of the last two larvæ, and absent from the rest. Length 30 mm.

The comparison between figs. 1—5 (Plate XVI.), shows the chief steps of the transition from the greenest to the darkest larvæ, but many intermediate steps are necessarily omitted. These are, however, indicated in the tabular form given below, which summarises the results of the comparison made above. The real break is between the three green larvæ and all the rest, and the differences between the former far outweigh those between the latter. Hence the following classification expresses the relation between the varieties:—

	Green varieties.			Dark varieties.					
Degrees of colour	1	2	3	4	4 *a*	4 *b*	4 *c*	4 *d*	4 *e*
Division I. of the last stage	(1)*	....	....	(2)*	(3)	(4)	(5)	(6)	
Division II. of the last stage	....	(1)	....	....	....	(2)	(3)	....	(4)*
Division III. of the last stage	....	....	(1)*	....	....	....	(2)	(3)* (4)	(5)

The asterisks indicate the larvæ which are figured on Plate XVI. It is very curious that each of the three divisions should have produced a single green variety. In this stage, for the first time, the shade of the larvæ followed, upon the whole, the arrangement of the last stage; although the parallelism was far from being complete, as we see in the appearance of a green variety in the darkest division (III.). The bright orange spiracles form a very prominent feature in this stage, together with the bright yellow longitudinal stripes in some of the dark varieties (see fig. 4). At the close of this stage, during the resting-period, the prothoracic

dorsal plate became very conspicuous, the cuticle around it being thrown into wrinkles from the strain to which it was exposed, while the denser and thicker plate was able to resist the strain. Its appearance is shown in Plate XVI., fig. 11 × 7. The plate, being darker in colour and without wrinkles, is very prominent against the surrounding cuticle.

The 6th larva of Division III. was mature in Stage III. on Oct. 8th; on Oct. 10th it had entered the resting-period; on Oct. 12th (4.30 p.m.) it had just changed its skin. The larva was that known as (8) in the division of 10 pale larvæ of the 2nd stage (see comparison at end of 3rd stage). It is represented, in the 3rd stage, on Plate XV., fig. 12. This larva died on Oct. 16th: it was apparently a *very* dark variety, but was not sufficiently advanced in the 4th stage for a safe comparison with the other dark larvæ.

Data as to the 4th change of skin and the lengths of the larvæ are given below:—

Dates.	Division I.	Division II.	Division III.
Oct. 10th	11 p.m. 3 largest larvæ in resting-period; 40·0, 40·25, and 42·5 mm. in length.		
Oct. 11th	2 of the larvæ are more extended, reaching a length of 41 25 and 45·0 mm.	....	1 larva in resting-period, 39·25 mm. in length, but not greatly extended.
Oct. 12th	9 p m. The green variety is now in resting-period.	2 larvæ in resting-period, including the green variety; latter 39·0 mm. when not much extended; former 43·0 mm.	2 more in resting-period.
Oct. 13th	9.15 a.m. 1 dark variety has just changed skin; the other 5 all in resting-period. Evening: same.	Morning: 1 more in resting-period. Evening: same.	Morning. 4 larvæ now in resting-period: the green variety the only one still feeding.
Oct. 14th	Morning: same. 5.30 p.m. Another dark variety was changing its skin.	Morning: same.	Same.
Oct. 15th	5.30 p.m. A dark larva just changed skin.	Evening. The last larva in resting-period.	Evening. The green variety is now in resting-period.

Dates.	Division I.	Division II.	Division III.
Oct. 16th	....	4.15 p.m. 1 larva had just changed skin.	Morning. 1 dark larva had changed skin some little time. 3 p.m. Another larva just changed skin. 10.40 p.m. Another has changed some few hours.
Oct. 17th	8.30 a.m. The green larva has changed skin some hours, and is now a dark variety. The two dark larvæ in the resting-period were 35·75 mm. in length when contracted, and 38·5 mm. when extended. 12.30 noon. 1 of them is changing its skin. 8.15 p.m. The last has almost finished changing skin.	8.30 a.m. 2 larvæ have changed skin, the green one being among them. The last larva in resting-period is the lightest of the dark varieties. It is 43·0 mm. in length when thoroughly extended.	The green larva in resting-period is 36·5 mm. long, being rather small; the other 40·5 mm. when contracted, 43·3 mm. when extended. 8.15 p.m. The latter has nearly changed its skin.
Oct. 18th	....	10.25 a.m. The last larva was changing its skin: at 10.35 a.m. the change was complete, and the appearance of the 6th abdominal segment was painted by 11.45 a.m. (Pl. XVI., fig. 12 × 7).	1.40 p.m. The green larva changed its skin.

Stage V.—All the larvæ became dark varieties in this stage. Immediately after change of skin the colour had not darkened into its permanent shade. Thus the head was yellow and green. The dorsal prothoracic plate, the anal flap and horn, were the lightest parts of the larva, immediately after ecdysis. It is probable that this is due to the protection afforded by the thickness or density of the cuticle over these parts, including the head. The darkening of the larva being due to the action of the air, it is probable that these parts alone would be completely protected from it until after ecdysis had taken place.

The shagreen tubercles of the previous stage are very distinct before the colours have darkened, appearing as white circular areas, surrounded by a rather deeper shade of ground colour, each containing a dark point in

the centre. This appearance is shown in Plate XVI., fig. 12 × 7, representing the 6th abdominal segment immediately after ecdysis. The areas are the scars of the old tubercles, the dark central points are the rudimentary tubercles of the 5th stage which still continue to bear minute hairs. It is probable that many of these fall off later in the stage. The explanation of the circular scar is as follows:—The comparatively light purplish or yellowish ground colour alone present after ecdysis, is *subcuticular* in position, being contained in the hypodermis cells. This colour is not formed in the hypodermis cells which are beneath the comparatively large shagreen tubercles of the previous stage. The dark colour which subsequently appears, is *cuticular* in position, and extends over the colourless hypodermis, and thus conceals the great majority of the circular areas.

Above the subdorsal line the ground colour is at first purplish, the borders to the stripes are also purplish, deepening into blue in the centre of the darkest part, corresponding to the position of the red spot in earlier stages; (see Plate XVI., fig. 12 × 7, illustrating the arrangement and tints of the ground colour, and the scars of the shagreen dots, as seen immediately after ecdysis, in the 6th abdominal segment). Below the subdorsal the ground colour is yellow or yellowish green. The thoracic legs are red, black at the tip. The horn is reddish orange at its base, yellow at the upper part and tip. The head is yellow, but the parts which will become dark, are green. The prothoracic plate is at first much swollen and green. Three of the chief tubercles are black and distinct on each side of each abdominal segment (see fig. 12, in which two of these structures are shown); the tubercles bear long and prominent hairs.

This examination of the larva immediately after ecdysis is evidently of great importance, the stripes and borders bearing much resemblance to those of the larva of *Acherontia atropos* in the last stage. It is probable that this method of examination will yield interesting and important results, if extended to larvæ generally. As hinted above, it gives us the opportunity of describing the colours due to pigment in the hypodermis cells, before everything is concealed beneath the superficial pigment which is formed in the cuticle.

Comparison of larvæ in the 5th stage.—The larvæ were

compared on Oct. 20th, when they had apparently taken their permanent colour. There were, nevertheless, some few modifications due to slight changes which happened subsequently. The larvæ were examined in the following order.

Division II. of the earlier stages (omitting the green variety of the last stage).—All three larvæ were *very dark*, the ground colour being black; the subdorsal line was represented by a single spot on the anterior margin of each segment, except anteriorly, where it was continuous; the subspiracular line was light and prominent. All three were *very* similar, except for slight differences in the size and distinctness of the light subdorsal spots, and in the distance over which the subdorsal formed a continuous stripe. There were very faint traces of oblique stripes on two of the larvæ. The length varied from 50·0 to 65·0 mm.

Division I. of the earlier stages (omitting the green variety of the last stage).—Of the five larvæ, three were dark like those last described, one of them being even darker, and possessing no indication of the oblique stripes, while the subdorsal was very slightly represented by a single spot on each segment. This larva is represented on Plate XVI., fig. 10, natural size. The two other dark larvæ possessed traces of the oblique stripes like the two larvæ of Division II.

The two remaining larvæ were lighter varieties, one of them with the subdorsal distinct for its whole length, and expanded into a distinct spot at the anterior margin of each segment. Above it was a dorsal line upon each side, similarly expanded into spots; traces of stripes were present. This larva is represented on Plate XVI., fig. 7 (natural size). The other larva only exhibited traces of the dorsal line, and the subdorsal was less distinct; the stripes were similar.

Division IV. (including the two greenest varieties of the last stage). These two larvæ were separated from their divisions, shortly after ecdysis, on Oct. 17th. The darker variety was the larva removed from Division II.

The latter larva was dark; the subdorsal being only represented posteriorly by a single large distinct spot upon each side of each segment, but it was continuous upon the thoracic segments. Traces of the stripes were present. This larva is represented in fig. 9 (natural size).

The other larva was light, and (at this time) intermediate between the two lightest larvæ of Division I. Its appearance is represented in fig. 6 (natural size). Both these larvæ were kindly preserved by Lord Walsingham, and are now placed in the Natural History Museum, so so that they will be always available for comparison.

Division III. of the earlier stages (omitting two larvæ, one having died in the 4th stage, while the green variety was put in spirits shortly after ecdysis: it is quite clear that the latter larva would have been dark). All four larvæ were dark varieties; three being *very* dark indeed, with small spots representing the subdorsal line, and hardly any trace of the oblique stripes. In one case these spots were almost absent, and there was no trace of the stripes. The fourth larva was remarkable, in that the subdorsal line and stripes were distinct, the former for its whole length, although the larva was a dark variety. This latter larva is represented in fig. 8 (natural size).

All the fourteen larvæ were arranged in the order of relative darkness as follows:—

Degrees of colour.	1. The darkest larvæ.	2. Equally black, with moie distinct subdorsal spots and traces of stripes.	3. Equally black, but subdorsal continuous, and stripes distinct.	4. Ground colour browner and less dark.	5. Ground colour still browner and less dark.	6. Ground colour still browner and lighter: the dorsal lines distinct.
Division II. ..	1	1 1°				
,, I. ..	1*	1 1°	....	1	....	1*
,, IV. ..	....	1*	....	....	1*	
,, III. ..	1	1 1°	1*			

The asterisks are affixed to the larvæ which were figured; they are shown in figs. 6—10 on Plate XVI.

The larvæ marked ° possessed a light-coloured and extremely prominent subspiracular line; in the others this line varied from a light brown colour, almost like the marked larvæ, up to a distinct brown tint; but this feature was always extremely distinct, and formed by far the most prominent marking of the larvæ. The horn is now curved and shining, like that of *Sphinx ligustri* in the last stage. The prothoracic dorsal plate is very distinct and polished (see figures).

The larvæ were re-compared Oct. 25th, when the four largest were 80—90 mm. in length, varying with the degree to which they were stretched. The relative darkness was the same as on Oct. 20th, except in the case of the two lightest larvæ, of which the position was now the reverse of that previously noted. The lightest larva was, therefore, the lighter of the two in Division IV. (Plate XVI., fig. 6); while the next lightest larva was the lightest of Division I. (Plate XVI., fig. 7). This relative position is indicated in the order of the figures on Plate XVI., but the arrangement of the previously-given tabular form requires to be modified in this respect, if it is to represent the order of the mature larvæ.

Comparison with other descriptions.—From a comparison with Mr. Buckler's four figures of this larva (Ray Society, 1886, Plates XXI. and XXII.), it appears that either his larva was exceptionally light, or mine were exceptionally dark; for the lightest of my larvæ were *much* darker than that figured by him. The subspiracular line, although very prominent, was not nearly so wide and distinct as that figured by Mr. Buckler. The other differences will be best seen on comparing the figures.

The appearance of my larvæ was also very different from that figured by Weismann (Studies in the Theory of Descent—'On the Origin of the Markings of Caterpillars.' Translated by Prof. Meldola. Plate III., fig. 16), especially in the tint of the ground colour. The subspiracular line was much like that shown in Professor Weismann's figure.

Habits of larvæ in last stage.—It has been stated that the larvæ conceal themselves in the earth or among brown leaves during the day. I think that this is most improbable, for I did not see the least tendency towards such habits, although I surrounded the larvæ with appropriate materials during the last stage. Mr. Buckler and others have made similar observations leading to the same conclusion (*l. c.* p. 23).

The larvæ are extremely irritable when touched, ejecting from the mouth, on the slightest provocation, large quantities of a green fluid, containing fragments of leaves. This habit is quite unknown in *Smerinthus*, *Acherontia*, or *Sphinx ligustri*, except when the larvæ are excessively irritated. It is, however, well known to

occur in *Deilephila euphorbiæ*. The habit did not take place in the earlier stages of *S. convolvuli*. When irritated, the mature larvæ curled up and remained in this position for a very long time.

They were fond of drinking the drops of water which were sometimes introduced on the food-plant.

They freely ate the brown and withered leaves which were occasionally introduced when the plant became frost-bitten in late autumn.

The antennæ were in a state of continual and rapid vibration.

The *Sphinx* attitude was never observed in the large larvæ. This fact is, doubtless, due to the usual horizontal position upon a food-plant, which chiefly creeps along the ground. This will be again alluded to in discussing the significance of the attitude.

Lengths of mature larvæ and times at which they ceased to feed. Seven out of the fourteen larvæ were preserved at various times in the last stage.

Oct. 29th.—Division III.: 3 out of the 4 larvæ had been preserved, the remaining larva No. (3) in the table of comparison, probably ceased feeding Oct. 27th, or even a day or two earlier; it had certainly ceased feeding on Oct. 28th. This larva was 73.0 mm. long when extended in walking, but it was somewhat contracted by this time.

Division I.: 2 out of the 5 larvæ (Nos. (1) and (6) in the table) had been preserved; of the remainder, the lightest larva (No. (4)) ceased feeding at about the same time as the larva mentioned above. The 2 larvæ still feeding at this date were 72·0 mm. when at rest, about 76·0 mm. when extended in walking.

Division II.: Of the 3 larvæ, 1 ceased feeding probably on Oct. 28th; 1 of the 2 still feeding was 75·0 mm. when moderately extended at rest.

Division IV.: Both of these larvæ were preserved.

Oct. 30th.—Division I.: 1 larva still feeding, 1 walking about hurriedly as if preparing for burying; the former, 75· mm. in length when comfortably extended, the latter rather larger, but in a somewhat contracted state. Both larvæ, if stretched, would reach 80·0 m.m.

Oct. 31st.—Division II.: Another larva had ceased feeding at this date; the larva still feeding was 85·0 m.m. long when extended, and was thus considerably larger

than those which had ceased feeding (which were respectively about 70·0 and 75·0 mm. long when extended in walking.

Nov. 1st.—Division I.: The last larva ceased feeding Oct. 31st.

Division II.: The last larva ceased feeding at this date, or on Oct. 31st.

Although the larvæ burrowed, and in one or two instances constructed earthen cells, not a single one pupated. Their dead bodies were found when the earth was examined at the time when the moths should have emerged in 1888. This could not be traced to any treatment which they had received; the earth was moist, and besides their death took place at too early a date to have been produced by dryness. The lengths of the mature larvæ were certainly less than in those which are found in the wild state. Thus Mr. Buckler describes a larva as being 4 in. in length (*l. c.*), while mine were not much over 3 in. in any case.

The larvæ were fed upon *Convolvulus arvensis*, except during the last few days, when it was difficult to obtain a sufficient supply of food, because of the frosts. *Convolvulus sepium* was then supplied with the former food-plant, and the larvæ ate both indiscriminately.

GENERAL CONCLUSIONS.—DURATION OF LARVAL LIFE.—The duration of the stages and the lengths of the larvæ may be estimated as follows .—

Development in the egg	10 days.	Length of newly-hatched larva, 3·75 mm.
Duration of Stage I.	.. 9½ „	Length at end of Stage I., 8·25 mm.
„ „ II.	.. 8 „	„ „ „ II., 14·0 „
„ „ III.	.. 8½ „	„ „ „ III., 24·0 „
„ „ IV.	.. 12 „	„ „ „ IV., 41·0 „
„ „ V.	.. 13 „	„ „ „ V., 80·0 „

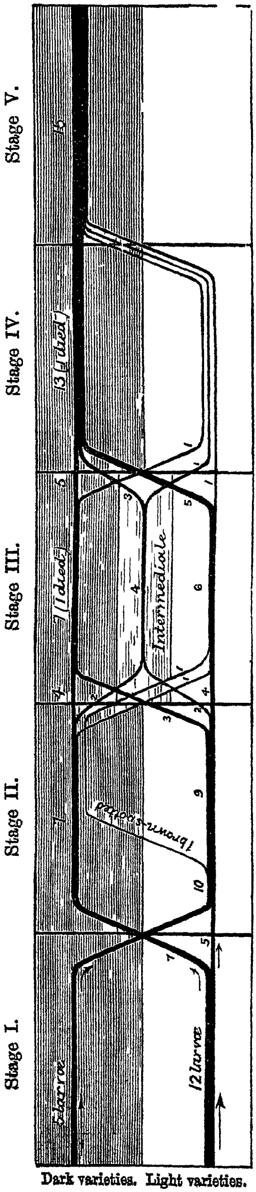
Each of these figures was estimated from the data given at the end of each stage. The whole period of larval life may be taken as extending from about Sept. 8th to about Oct. 29th—a period of fifty-one days. If the estimated lengths of the five stages be added up, it will be found that they also come to fifty-one days. It is therefore almost certain that the estimated lengths of the stages are very nearly correct, and they were obtained on the supposition that the larvæ which first changed their skins at the end of any stage would be the first to change them at the end of the succeeding stage. This

conclusion is also based on a very general experience of larvæ. It is therefore probable that an unusually short development in the egg only causes a corresponding protraction of the *first* stage. It is probable that larvæ emerge from the egg with very varying amounts of unassimilated nutriment, and that those with the smaller amounts have carried on the process of assimilation to a greater extent in the egg itself, and therefore emerge at a comparatively late period; while, conversely, those with the larger amounts hatch comparatively early, but are compelled to continue the process outside the egg. Hence the length of the first stage would be correspondingly greater in the latter case, but no effect would be produced upon the later stages. It is to be hoped that these possible conclusions may be tested by observations especially directed towards this point.

It is probable that the length of larval life was unusually great, and that the larva becomes mature at an earlier period in the localities in which it breeds regularly. The closely-allied *S. ligustri* has a larval period of about five weeks, and the same is true of *Smerinthus ocellatus*. In this country the leaves of the food-plant are extensively killed by frost during a period which corresponds to the last part of the larval life—a time when growth is especially rapid. I could only obtain food by searching here and there in many places, and my larvæ would certainly have perished of starvation in the wild state. In addition to this, the larval life would have been somewhat longer in the latter state, for the larvæ were kept indoors at a comparatively high temperature. They were fed so carefully throughout, and the food was kept so fresh, that there was no protraction of life owing to the causes which frequently operate upon larvæ in captivity. Temperature has a very great influence upon the length of larval life, as I have especially observed in the case of *Smerinthus ocellatus* during the past cold summer (1888). It therefore seems probable that this larva pupates comparatively rarely in this country, and that in warmer countries the larval life is shorter, approaching that of *S. ligustri*.

The alternation of dark and light varieties in the successive stages. — This alternation was very marked in many larvæ in all the stages except the last, in which all the larvæ became dark varieties.

DIAGRAM I.



Dark varieties. Light varieties.

The accompanying diagram (I.) serves to show in a graphic manner the way in which the larvæ oscillated backwards and forwards between the dark and light varieties during the successive stages. It must be understood that the dark varieties of (*e.g.*) Stage I. do not contrast with the light varieties of the same stage in the same marked manner as the two varieties of (*e.g.*) Stage IV. contrast together. Nevertheless the two varieties of the former were very different in this respect, and we should have expected that the darker larvæ exhibited traces of the darkness which became more manifest in later stages. So also we might well have supposed that the single larva which exhibited marked indications of the dark borders in Stage II. would have been among the number of those in which this character was principally developed in the next stage, instead of among those in which it was least developed.

It is much to be hoped that these surprising results will be carefully tested in other species. It would be well to keep a large number of individuals entirely separate, in order that the results may be analysed with greater accuracy.

No variable colour-relation between these larvæ and their surroundings. — It is well known that the green form of these larvæ often persists into the last stage. Thus I was assured that this variety is commoner than

the other in the Canary Islands and in Madeira. In the larvæ above-described it has been seen that three individuals retained the green ground colour in the 4th stage, while all the others lost it. Under these circumstances, it might well have been supposed that the larvæ would exhibit the power of variable protective resemblance which so many species are now known to possess. Thus *Rumia cratægata* can be rendered brown or greenish; while greater or less variation in the depth of the brown ground colour can be caused in *Crocallis elinguaria*, *Ennomos angularia*, *E. lunaria*, *Boarmia rhomboidaria*, *B. roboraria*, *Catocala sponsa;* and variations in the green colour of *Smerinthus ocellatus* and *S. ligustri.** Other instances occur, and this power is doubtless very widely spread among larvæ.

It is, however, certain that *S. convolvuli* does not possess this power in any marked degree, and it is probably entirely wanting. My larvæ were fed in glass cylinders placed upon white plates, and the food was always kept green and fresh. Only in the last stage were brown surroundings (earth and dead leaves) introduced, in order to test the opinion that the larvæ conceal themselves. The complete absence of brown surroundings in the earlier stages would have produced light-brown or green individuals of nearly all all the species above-mentioned, and yet the *convolvuli* larvæ became exceptionally dark. It is therefore probable that the predominance of dark varieties in one locality, and green in another, is due to the ordinary operation of natural selection upon the two forms of a dimorphic species, tending to exterminate a relatively larger number of the variety which harmonises less with the surroundings in each locality.

The regular food-plant of the species in this country and over the great part of Europe is *Convolvulus arvensis* (the larva being comparatively rare upon *C. sepium*). The

* Professor Meldola was the first to bring together the scattered examples of this kind, and to draw attention to the general principle which they involve: see his paper, 'On a certain class of variable protective colouring in insects' (Zool. Soc. Proc., 1873, p. 153). Since then, many further details have been worked out: although some of the above-mentioned examples have not yet been published. See my papers in Proc. Roy. Soc., vol. xxxviii., p. 269, and xl., p. 135; also 'Report of British Association,' 1887, p. 756. The case of *Boarmia rhomboidaria* has been investigated by my friend and pupil, Mr. R. C. L. Perkins, of Jesus College, Oxford.

small size of the leaves of the former small species, and its habit of creeping along the ground, renders it a less efficient protective back-ground for a very large larva, than the brown earth itself. Accordingly, we find that the larvæ are green in the early stages, when they are comparatively small, but become brown in later stages. But in the Canary Islands and Madeira the conditions are different in that there are many species of *Convolvulus*, including several large-leaved forms, which do not, as a rule, creep along the ground, and which would make a far more continuous back-ground of green. Thus, in Madeira, Dr. Grabham informs me that the species very commonly feeds upon the Sweet Potato (*Batata edulis*)—a large-leaved *Convolvulus*. Again, the specimens of the moth which were shown to me in the Canaries were *far* smaller than those found in Europe, being, in fact, smaller than *S. ligustri*. In Madeira, also, Dr. Grabham showed me a living pupa which had been obtained from a wild larva which had been found when full-fed, and which was probably therefore of normal size. The pupa was very small for this species, and, I believe, smaller than that of *S. ligustri*. Hence the smaller size of the mature larva in these islands, and the more efficient back-ground afforded by the food-plants, cause the green varieties to gain more protection than the brown ones, and we therefore see that the former predominate.

Such cases help us to understand the value of dimorphism, quite irrespective of its obvious use when the species possesses the power of variable colour-relation to the surroundings.

The red spots and coloured borders in Sphingidæ.—Although it seems probable that the red spots are connected with the origin of coloured borders in this species, I do not yet see sufficient reason for the belief that these spots are on the way to become borders in the larvæ of *Smerinthus*, although the observation appears to tend in this direction. I believe that a careful investigation of the ontogeny of the larvæ of the genus *Sesia* is greatly wanted, and would help to throw light upon this and many other points. During the past summer, the materials for such an investigation were supplied me by George Tate, of Lyndhurst, but the press of other work prevented me from doing more than enough to lead to the opinion expressed above. I hope to be able to work at these species next year, if larvæ are still obtainable.

2. The Ontogeny of Aglia tau.—My attention was first directed to this species through the kindness of Mr. William White, who showed me some preserved larvæ of different ages in his possession. The immense difference between the young and the mature larvæ,—the forked caudal horn in the former, considered in relation to the general spinous covering of many larvæ on the one hand, and on the other to the forked horns of young *Sphinx* larvæ, which are placed in precisely the same position,—the terrifying marks of the older larvæ,—were some of the interesting points suggested by the examination of Mr. White's specimens. I therefore determined to work out the ontogeny of this species of larva as soon as the opportunity permitted. I obtained twelve living pupæ in the autumn of 1886 from Messrs. Watkins and Doncaster, and I was also supplied with living ova from the same quarter in 1887. Dr. F. A. Dixey consented to take half of these ova, and the larvæ which hatched from them were reared by him; so that I have the satisfaction of knowing that my results are confirmed by those obtained by this careful observer. In the following account especial attention will be paid to comparison with the known ontogenies of *Sphinx* larvæ.

Habits of the moths in confinement.—Although this species belongs to a group in which the males "assemble," I found it very difficult to induce the moths to pair. In many cases the males and females emerged at nearly the same time, and ultimately died without having taken any notice of each other. In one single case, however, I found two moths paired, about 3 or 4 a.m., but they had separated a few hours later. The relative development of the male antennæ seems to indicate that their habits must be very different in the wild state, and it is probable that the freshly-emerged female is scented from a very great distance by means of these highly specialised sense-organs. Dr. Dixey has also noticed very similar facts in the captive imagos of *Saturnia carpini*.

Ova.—In addition to the purchased ova, I obtained about sixty eggs from the single fertile female mentioned above. These were laid as follows:—April 15th, 2; 16th, 4; 17th, many; 18th, many; 19th, a few; 20th, the moth died.

The ova were of very large size, being about 2·5 mm.

by 1·9 mm.: they were rather flattened on the upper surface, and a slight central depression appeared. The ovum shown in Plate XVII., fig. 2, × 7, was drawn from the edge. The shape was very like that of *Smerinthus* or *Sphinx*, but the size was somewhat larger, and the dark brown colour very different from that of any *Sphinx* hitherto described. This colour is, however, an obvious adaptation to the habit of oviposition upon bark instead of leaves.

Stage I.—The following observations were conducted upon seven sets of larvæ, arranged and fed as follows: —One set of 15 larvæ upon *birch;* three sets of 4, 4, and 7 larvæ upon *beech;* three sets of 8, 8, and 9 larvæ upon *copper-beech.* The larvæ hatched upon the following dates:—

May 16th,—15 larvæ.
,, 17th, 18th, 19th,—15 larvæ.
,, 20th, 21st, 22nd,—12 larvæ.
,, 23rd, 24th,—13 larvæ.

Hence the period of development in the egg appears to occupy about 31 days. The lengths of the stages will be chiefly taken from the larvæ which hatched May 16th, as these were kept together, and constituted the set fed upon birch.

The newly-hatched larvæ are 6·25 mm. long, this and all other measurements being taken from the anterior part of the head to the posterior end of the short red spine which terminates the anal flap. The caudal and thoracic spines were always excluded from the measurement, because the length of the larva would have varied, according to the angle at which they were held.

Although the size of the aperture through which the larvæ emerged varied considerably, they did not eat large amounts of the shell as in *Sphinx, Smerinthus,* &c. An examination of the empty shells makes it probable that the larvæ do not eat the egg-shells after emergence.

The long caudal horn of the young *Sphinx* larva is of the full length immediately after hatching. Before hatching it is quite soft, and is curved round inside the egg-shell, and closely pressed against the latter, so that it can be plainly seen by the use of a lens. In *Aglia,* however, there are the four long thoracic spines in addition to the caudal horn, and they are all disposed

in a very different manner in the egg. They take the form of comparatively small curved tubercles, the cuticle of which is thrown into wrinkles. See Plate XVII., figs. 1, × 9 and 2, × 7, showing the appearance of the newly-hatched larva; compare with fig. 3. The spines possess this appearance when the larva first hatches, and are gradually expanded in the course of about twenty minutes by the contraction of the walls of the body, which forces blood into them. When thus expanded to its full extent the cuticle becomes hard and rigid, so that the shape is permanently fixed. This interesting arrangement is doubtless an adaptation rendered necessary by the size and number of the spines, which in their expanded form would occupy too large a space in the egg. The process is, in fact, entirely analogous to that by which the large wings of the lepidopterous imago are contained within the relatively small wings of the pupa. The advantage has been conferred and the difficulty met by similar adaptations. It is probable that a similar method for the production of rigid bristles or spines, after emergence from the egg, or after change of skin, will be found to be not uncommon among lepidopterous larvæ. A superficial examination of the larvæ of *Vanessa Io* immediately after the last ecdysis seemed to indicate that the same process occurs in them, but I have preserved some of the larvæ at various stages, and hope to investigate the subject by the microscopic examination of prepared sections. It is probable that the process is not in all cases one of *expansion* alone, but that there is also a partial *eversion* of the structures or of the secondary spines upon them.

The striking appearance of the larva in this stage is shown in Plate XVII., fig. 3, × 7.

It will be necessary to enter into a somewhat minute description of this stage of which the appearance is almost identical with that of the two following stages. The ground colour is bright green, with a darker median dorsal stripe caused by the underlying dorsal vessel: along each side is a white subspiracular line, which terminates anteriorly in the base of the prothoracic spine, while posteriorly it passes along the margin of the anal flap, and ends at the base of the red terminal spine. There are seven complete oblique white stripes upon each side sloping in a posterior direction, with the

appearance and relation to the segments indicated in fig. 3. The first stripe begins on the 1st abdominal segment; the last ends on the 8th: there is also the posterior lower part of an additional stripe on the 1st abdominal segment. Too much importance must not be attached to the fact that the stripes slope in a reverse direction to that commonly occurring in *Sphingidæ*, for undoubted *Sphinx* larvæ (*e. g.* the genus *Sesia*) possess similarly reversed stripes. Each stripe consists of two halves,—the upper and anterior upon one segment, the lower and posterior upon the segment immediately behind the latter. Hence each of the first seven abdominal segments is crossed by the upper part of one stripe, and also by the lower part of the stripe which is immediately anterior to the former. In the thoracic dorsal region there are two parallel and nearly horizontal white stripes upon each side, which seem to represent the similarly-placed white lines in the young *Sphinx ligustri*: (if this comparison holds, the lower of the two must constitute the persistent anterior part of a lost subdorsal line, as in the last stage of *Smerinthus ocellatus*). Four white spine-bearing tubercles occur upon each abdominal segment from the 1st to the 7th inclusive. These tubercles bear a constant relation to the two parts of the oblique stripes and the subspiracular line upon each segment. The uppermost or first and largest tubercle is placed upon the anterior part of the upper division of an oblique stripe: the second and smallest tubercle is situated midway between the two divisions of a stripe: the third (and second largest) tubercle is placed upon the lower division of a stripe: while the fourth (and third largest) tubercle rises from the subspiracular line. Two large diverging bristles spring from the summit of the first tubercle, and each of the others also bears a bristle which is forked to a greater or less extent; even the rudimentary second tubercle bears a bristle with a bifid extremity. In addition to these chief terminal bristles, other smaller ones can be made out upon the tubercles. Towards the end of the stage each abdominal segment from the 1st to the 8th becomes strongly marked by a transverse dorsal ridge, which forms a very prominent feature in all the other stages (see fig. 5). Each tubercle of the first pair rises from a fleshy elevation

upon this ridge, and thus becomes even more conspicuous. Posterior to the second tubercle, and on a rather lower level, are two minute white dots, one or both of which may perhaps represent the additional tubercle seen in *Sphinx* larvæ; but more probably the posterior of the two strongly-marked bristles on the first tubercle represents the posterior of the two dorsal bristles which rise from separate tubercles in young *Sphingidæ*. The arrangement above described will be found to closely resemble that present upon the larva of *Sphinx convolvuli* in the first stage (see Plate XV., fig. 2), and other previously described *Sphinx* larvæ (*S. ligustri*, *S. ocellatus*, &c.). During the past summer I have had the opportunity of examining the newly-hatched larvæ of *Sesia fuciformis*, and the very remarkable furcate spines on the dorsal tubercles evidently represent and strongly suggest the double spines on the first tubercles of *Aglia*. I have described the tubercles of *Aglia* in some detail, because it is impossible to fully represent them in a drawing of the size represented in fig. 3. The single median spine which certainly represents the caudal horn of *Sphingidæ*, and which will in future be called by this name, takes the place of the two first tubercles on the 8th abdominal segment. The two branches into which the horn diverges at its extremity, probably represent, as Wilhelm Muller suggests, the essentially double nature of the structure, which has arisen from the coalescence of two dorsal tubercles. The only apparent objection to this homology is the precisely similar structure and appearance of the four thoracic spines, which at first sight seem to render it difficult to consider that each of these latter is morphologically equivalent to only one half of the caudal horn. It is, however, probable that they may represent the two dorsal tubercles on each side fused together in a longitudinal direction, just as the caudal horn represents a single pair which has coalesced in a transverse direction. The planes in which the bifurcation of the spines takes place respectively, seems to support this interpretation. Furthermore, the two highest dorsal tubercles are represented by a double tubercle on each side of the 2nd and 3rd thoracic segment in the young *S. convolvuli* (and in many other larvæ: see, for instance, the figure of *Euclidia mi*, Plate XVII., fig. 8, × 24·5).

The five spines are covered with large thorn-like processes, each of which emits a single bristle, while especially large bristles project from the extremities of each prong of the terminal fork. The structure is therefore essentially similar to that of the caudal horn in all young *Sphingidæ* hitherto described. As far as the thorny appearance is concerned, the resemblance is to the caudal horn of the second and third stages of *Sphinx* rather than the first stage, while the bifurcation of *Aglia* is chiefly recalled by the condition of the first stage of *Sphingidæ*, in which it is most marked. These differences in the condition of the horn in successive stages have, however, only been *carefully* studied in *S. convolvuli* among *Sphinx* larvæ, although there is no reason to doubt their occurrence elsewhere (compare Plate XV., figs. 8, 9, and 16, with Plate XVII., fig. 4, × 50). The five spines of *Aglia* are bright red (like the caudal horn of *Smerinthus ocellatus* in the three first stages), except for one section of their length, in which the pigment is absent, and the structure is white and comparatively transparent. This section is situated nearer to the fork than the base of the spines (see Plate XVII., figs. 3 and 4). I was greatly interested to find even this character represented in the caudal horn of the 2nd, 3rd, and 4th stages of *Sphinx convolvuli*, which is deeply pigmented (in this case with black) at the tip and base, but of which *a short section, nearer to the former, is white and more or less transparent* (see Plate XV., figs. 9 and 16, &c.).

When the larvæ are irritated they move their spines, especially the 3rd thoracic pair. The usual position of the spines during rest is shown in Plate XVII., fig. 3.

It will be remembered that the caudal horn of the larval *Sphinx ligustri* in the 1st stage is also movable (Trans. Ent. Soc. Lond., 1885, p. 283).

In addition to the tubercles already described, and the spines which represent certain of these structures, there are also other similar tubercles on the thoracic segments, and on the abdominal segments posterior to the 7th. The appearance and arrangement of these is to some extent shown in fig. 3, but peculiar interest attaches to the two pairs of tubercles between the caudal horn and the spine on the anal flap (anal spine). Entirely independent investigations (upon the lepidopterous pupa) have long since convinced me that

Lepidoptera possess distinct traces of ten abdominal segments, that there are clear indications of two segments behind the 8th abdominal,—the last segment which bears a spiracle. These two rudimentary segments are clearly separated from each other in *Aglia*, and in many other larvæ, by a distinct constriction, parallel with that which separates them from the 8th abdominal segment. Each of these two additional segments is further emphasised by the possession of a pair of strongly-marked tubercles unmistakeably homologous with the 1st tubercles already described upon other abdominal segments. Similar homologies extending to other tubercles also can be traced in other larvæ: (see, for instance, the structure of these parts in a *Sphinx*, a *Noctua*, and a *Pyrale*, as shown in Plate XV., fig. 6, Plate XVII., figs. 8 and 9, respectively). But the distinctness of the 9th and 10th abdominal segments was especially impressed upon me in *Aglia*, because of the characteristic structure and appearance of the 1st tubercles, which are repeated upon each of them. (See also the accurate representation of these parts in many South American larvæ by W. Müller 'Südamerikanische Nymphalidenraupen,' Fischer, Jena, 1886, Plate I.).

The head of the larva is green and rounded, and bears a few scattered hairs in this and all other stages. The head thus possesses a very generalised shape and appearance, like that of the majority of *Sphinx* larvæ, and like the young form of those *Sphingidæ* in which this part has a peculiar and specialised shape in the older stages (*Sphinx* and *Smerinthus*).

Another very remarkable resemblance between *Aglia* and the *Sphingidæ* is seen in the characteristic *Sphinx*-like attitude assumed by the former. This attitude is assumed for the whole of larval life, but it is especially well-marked in the 1st stage, and I have noticed the same fact in *Sphingidæ*. The young *Aglia* larva always rests on the under side of the leaf, stretched along the midrib, or one of the chief lateral veins, exactly as in the young *Sphinx* or *Smerinthus*. No one of the many points of resemblance between these larvæ and the *Sphingidæ* so greatly impressed me as the absolutely characteristic *Sphinx*-like attitude which they invariably assumed at rest.

The first stage was very unusually long. I was able to calculate its exact length in the case of several larvæ with the following results :—

In	2	larvæ	the stage	lasted for	14 days.
„	1	„	„	„	15 days (the rest before ecdysis occupying 7 days).
„	3	„	„	„	15—16 days.
„	7	„	„	„	16 days (the rest before ecdysis occupying 8 days in the case of 4 larvæ).
„	10	„	„		over 16 days.

Hence it seems that 16 days is the most usual duration of the first stage, but nearly half this time is spent in the extraordinarily protracted rest before ecdysis. It therefore follows that the time spent in *growth* is by no means unusual. The larvæ at the close of this stage are between 10 and 11 mm. in length.

Stage II.—Several larvæ were measured immediately after the first ecdysis, and the length was found to be very uniform, not varying more than ·75 mm. The average length was 10·5 mm.

The old skin is eaten. On one occasion I saw a larva nibbling the cast skin of one of the spines; the upper red part and a portion of the white zone were eaten. Immediately after change of skin the head and spines are pale, although otherwise of the usual colour; they rapidly darken after exposure.

The colour and marking in this stage are almost identical with those of the last; and the *Sphinx*-like attitude is equally characteristic, as well as the position on the undersides of leaves. The most important difference is the appearance of shagreen dots, exactly like those of *Smerinthus* and *Sphinx*, in which these structures also become prominent in the second stage. A further resemblance is shown in the fact that each shagreen tubercle is terminated by a short bristle with a clavate end. The abdominal segments become more strongly marked off by an increased prominence of the transverse ridge upon the dorsal aspect of each of them. The upper and anterior part of each oblique white stripe is bordered posteriorly by a darker shade of ground colour (green). The first traces of the terrifying marks which become prominent in later stages, now appear, but they are probably absent at the beginning of the second stage. Upon the 1st abdominal segment, above the

white subspiracular line, which is composed of prominent fleshy lobes, a white area extends into the ground colour, over a segment of a circle. In the centre of this area is a dark reddish patch, which is usually slightly invaginated, and therefore hidden during rest behind the lobed upper margin of the subspiracular line. When the larva is irritated, increased contraction of the body-walls produces greater pressure upon the fluid contents of the body, and unfolds the shallow pouch-like invagination behind the lobes, thus exposing a greater surface of the white area, and rendering the dark centre visible. I observed that one larva in this stage possessed only the slightest trace of the terrifying mark upon one side, while it was entirely absent from the other. The size of the dark centre varies greatly, and when least developed no red pigment is formed, but a dark green centre is enclosed by a pale, whitish border. It will be remembered that the first appearance of the terrifying marks, in relation to the white subdorsal line, as described by We'smann (*l. c.*, Plate IV. and description), in the larvæ of *Chærocampa elpenor* and *C. porcellus*, is strikingly similar to that in *Aglia tau*. The differences chiefly follow from the arrangement by which the eye-like marks are concealed in the latter species, except when they are actually needed.

The terminal fork on the five spines is not so marked in this stage, and it becomes less so in the next. In a small proportion of the spines in this stage, and a much larger propoıtion in the next, the fork is entirely absent. This does not necessarily take place in *both* spines of either thoracic pair. Sometimes the result is due to the end having been nibbled or injured in some other way, but this is by no means always the case.

The larvæ varied from 15·5 to 17· mm. in length at the end of this stage, when resting before the 2nd ecdysis.

The 2nd stage lasted for about nine days in the majority of cases, about three days out of this time being occupied in the rest before the change of skin.

Stage III.—The larvæ are, as usual, about the same length at the beginning of this stage as at the end of the last, attaining an average measurement of about 16 mm. The appearance is almost identical, and the attitude and position exactly so. Some slight differences have

been already alluded to. The terrifying mark becomes slightly more distinct; the red anal spine is relatively shorter and less conspicuous. Distinct differences in the shade of green which forms the ground colour are now seen in some of the larvæ, but they are more common in the next stage.

The larvæ varied in length from 22·25 to 27 mm. in the resting-stage before the 3rd ecdysis. The 3rd stage lasted for about seven days.

Stage IV.—The larvæ were, on the average, about 24 to 25 mm. in length at the beginning of the stage, although they varied above and below these limits. The appearance of the larva is shown in Plate XVII., fig. 5 (nat. size), and the differences between this and all previous stages are seen to be very striking, for the conspicuous spines are lost, together with the red anal spine and the small tubercles. The shagreen dots, oblique stripes, and sub-spiracular line remain, the latter being especially conspicuous and edged above with a dark border. *Smerinthus* is similar in retaining the shagreen dots in the last stage, while *Sphinx* loses them. The shade of green ground colour is different above and below the sub-spiracular, being much darker below, and the surface of the three thoracic segments above the subspiracular, is of a deeper green than the corresponding part of the abdominal segments. Both these distinctions are also characteristic of certain *Sphingidæ* (*Sphinx ligustri*, and the green form of *Acherontia atropos:* Trans. Ent. Soc. Lond., 1886, p. 144). The ground colour also varies considerably in the different individuals, and the tints are almost exactly similar to those which have been the subject of experiment in *Smerinthus ocellatus*, and which also occur in *S. populi*. The differences may be best classified as bright yellowish green, dark bluish green, and intermediate. The yellowest larvæ possess a distinct bright green colour below the sub-spiracular line, while those which are of a duller green above, are characterised by a deep bluish green colour below. This almost exactly corresponds with the differences in *Smerinthus ocellatus*, where the shade of the *under* surface is always the most extreme test of the individual variations.

The strongly-marked separation between the abdominal segments remains, while the thoracic segments

present a very different contour on a lateral view (see Plate XVII., fig. 5). The whole anterior part of the larva is not unlike a caricature of a vertebrate head, with the terrifying marks in the appropriate position for eyes. The effect is increased by its suddenness for, as above-stated, these latter features are very nearly concealed during rest, and are only exposed upon irritation. The larva in fig. 5 is represented in its terrifying attitude. In fig. 6, × 5·25, the terrifying mark is shown during rest, when it is almost concealed. Its relation to the sub-spiracular and to the spiracle on the 1st abdominal segment are distinctly seen, together with the differences in the shades of the larval ground colour. The mark itself is intensely black, and it is in this stage, surrounded by a reddish area.

The spiracles are ochreous like those of *S. ligustri*. I did not note their colour in the earlier stages, but they are not then conspicuous. The larvæ now abandon the undersides of the leaves, and seek the twigs during rest. The Sphinx-like attitude is still distinct (see fig. 5), but is not so strongly pronounced as in the earlier stages.

There was some evidence that the tint of the ground colour can be modified by the surroundings, as in *S. ocellatus*. The following results were obtained with the food-plants employed :—

Larval tints.	Yellowish green.	Inter-mediate.	Bluish green.
Birch	2	1	8
Beech	2	2	5
Copper-beech	....	....	18

It seems probable that the effects produced by the purple leaves of the copper beech on the one hand, and by the green leaves of the beech and birch on the other, indicate a certain amount of larval susceptibility to the surrounding colours.

To my great surprise the 4th stage proved to be the last in the ontogeny. I have never before met with a lepidopterous larva with only four stages. Just before pupating and after the cessation of feeding, the larvæ became brownish upon the back, exactly as in the case of *S. ocellatus* and *S. populi*

The mature larva is about 45 mm. in length. (That

figured in Plate XVII., fig. 5, is rather larger, being 45·5 mm. in length). The 4th stage generally lasts from ten to twelve days, and the whole larval life, from hatching up to the change of colour before pupation, occupies from forty-two to forty-four days, although in some cases it may continue two or three days longer.

I have already shown that the markings of the mature larva can be plainly seen upon the homologous parts of the freshly-exposed and still undarkened pupa (see Proc. Roy. Soc., Vol. XXXVIII., p. 278). These markings form, in fact, a valuable guide to homologies. In the green, freshly-exposed pupa of *Aglia tau*, all the markings of the larva are very distinct, and the sub-spiracular line which forms so prominent a feature of the larva, and which is continued along each side of the anal flap to its extreme apex, is equally conspicuous in the pupa, and occupies an identical position in relation to the terminal anal spine, which in this species is blunt and covered with an immense number of irregular hook-like cuticular processes. Hence the position of the marking affords valuable confirmation of Mr. W. H. Jackson's identification of the anal flap of the larva, with the anal spine of the pupa. (See 'Forms of Animal Life,' by G. Rolleston and W. H. Jackson, 1888, p. 153).

The shape and texture of the rough, dark pupa in this species, also strongly suggests that of *Smerinthus populi*, but its affinities are evidently still closer to the pupæ of *Endromis* and *Saturnia*, inasmuch as one unique (as far as I am aware) anatomical point unites together the pupæ of these three genera—*viz.*, the situation of the first or prothoracic spiracle at the bottom of a comparatively shallow pit, so that the spiracle itself is distinctly visible. In all other pupæ with which I am acquainted, this spiracle is deeply placed at the end of a channel, the external end of which is often closed, and when open is sometimes defended in a special manner. When the mouth of the channel is closed, there is generally the indication of a former opening in the sculpture or shape of the pupal surface at this point.

Conclusions.—It will be well to shortly review this most interesting ontogeny, and to summarize the points of resemblance between the larvæ of *Aglia tau*, and those of *Sphingidæ*, also calling attention to anything which is peculiar to the former.

Resemblances.—

1. *Caudal horn:* Changes of size during growth; 2 terminal bristles; bifurcation; longest and moveable in early stages; colour and white zone; thorn-like processes.
2. *Oblique stripes:* as in *Sesia.*
3. *Subspiracular:* as in *Sesia, Macroglossa* &c.
4. *White thoracic lines:* as in *Sphinx ligustri*, &c.
5. *The appearance and arrangement of the chief tubercles.*
6. *Shape of head:* as in young *Sphinx* and *Smerinthus*, and adults of many other genera.
7. *Sphinx-like attitude;* and also the fact that it is chiefly marked in young larvæ.
8. *Position on leaves and twigs of food-plant*, at different times in larval life.
9. *Shagreen dots*, with bristles, and the times at which they appear and persist (*Smerinthus, Sphinx*).
10. *Individual differences in shade of ground colour:* as in *Smerinthus.*
11. *Distribution of shades of ground colour:* as in *Smerinthus, Acherontia, Sphinx.*
12. *Probable slight susceptibility of larval tints* to surrounding colours (*Smerinthus, Sphinx*).
13. *The colours of the spiracles in the last stage:* (*Sphinx*).
14. *Change of colour before pupation:* (*Smerinthus*).
15. *The shape and texture of the pupa:* (*Smerinthus populi*).

Nearly all these points of resemblance are *very* striking, and appear to prove that the larvæ have the closest affinity to the *Sphingidæ*, and especially to the genus *Smerinthus.*

Peculiarities and apparent differences.—

1. *Ova:* very different colour.
2. *Expansion of spines* immediately after hatching.
3. *The presence of four thoracic spines and the anal spine.*
4. *Absence (?) of subdorsal line.*
5. *The length of the first stage.*
6. *The ridges on abdominal segments.*
7. *The terrifying mark:* position and concealment during rest; but *origin* much as in *Chærocampa.*
8. *Loss of caudal horn* in last stage; but certain *Sphingidæ* also lose the horn.

` *Only four stages in Ontogeny.*

The points (1), (2), (6), and (7), are evidently adaptations to the peculiar conditions of the larva, and cannot be considered to prove any great divergence in affinity, any more than the various adaptations which form such sharp characteristics *within* the group of *Sphingidæ* themselves (such as the terrifying marks of *Chærocampa*, &c.). In the present state of our knowledge, we cannot venture upon an opinion as to the meaning of points (5) and (9). So small a number of larval ontogenies have been carefully worked through, that it is impossible to decide whether such characters are adaptive. The subdorsal line (4) may be represented in part, as I have already suggested. Points (3) and (8) in reality indicate affinity quite as much as divergence. Thus the caudal horn degenerates in size and shape in the later stages of many *Sphinx* larvæ. It nearly disappears in the last stage of *Chærocampa porcellus;* it is absent from all except the earliest stages (if indeed it is present in these latter) of *Deilephila vespertilio* and *Pterogon œnotheræ* (Weismann, *l. c.*, pp. 209 and 259). The ontogeny of *Aglia* is more exaggerated than that of any *Sphinx* larva. It commences with a more specialised caudal horn than that which any *Sphinx* possesses, and associated with a specialised remnant of the spinous covering of allied *Bombyx* larvæ; and suddenly at the last ecdysis, all these prominent features are lost, as completely as the horn is lost in the later stages of certain *Sphinx* larvæ.

The character indicated in (3) is of extreme interest,—not, indeed, as showing affinity with the *Sphingidæ*,—but with allied *Bombyx* larvæ, *with which the Sphingidæ are thus brought into association through Aglia.* This relationship will be discussed in the next paragraph.

3. The natural position of the Sphingidæ.—The most interesting question raised by the ontogeny of *Aglia tau* is that of the position of the *Sphingidæ.* I have enumerated a large number of important characters, in which this larva is related to the *Sphingidæ* and especially to the genus *Smerinthus.* These characters are so numerous, that it is, I think, impossible to explain them as due to recent convergence caused by adaptive changes. The pronounced condition of some of the most striking

of these characters in the early stages, and their subsequent diminution or complete disappearance, in both *Aglia* and *Sphingidæ,* is strongly opposed to such an interpretation.

I have examined a large number of figures of the larvæ of tropical *Sphingidæ*, and of genera allied to *Aglia*, in order to see if further light can be thrown upon the subject.

The results of this comparison lead to the following conclusions. The tubercular covering of Saturnian larvæ is frequently developed into a spinous covering, especially in the genus *Attacus*, the change being doubtless protective. There is a tendency towards the special development of a single median dorsal spine on the 8th abdominal segment, and of several spines upon the thoracic segments. As these spines increase in size, they usurp the protective functions of those upon the rest of the body, which begin to lessen in size. The most complete transition between the extremes can be made out. As the thoracic spines become more important, further specialisation takes place, and the dorsal pair upon the 2nd and 3rd thoracic segments become far more important than the others. Finally the specialisation reaches a pitch equal to that attained by *Aglia*, with four large thoracic spines, and the large caudal horn, all the other elements being reduced to a minimum. There is, however, this difference, that the anterior pair of thoracic spines is upon the prothorax of *Aglia*, and upon the mesothorax of the species of *Ceratocampa* (*Attacus*). Furthermore, the five chief spines of certain species of *Attacus*, do not possess the forked terminations and certain other details which unite *Aglia* so closely to the *Sphingidæ*. In one species (*Rhescynthis erythinæ*), evidently closely allied to *Ceratocampa*, and placed immediately after it by Burmeister ('Atlas of the Lepidoptera of the Argentine Republic.' Plate XXI., figs. 1 and 1 A), the young larva (fig. 1 A) has a distinct caudal horn, and a smaller horn behind it (probably upon the 9th abdominal, like the anterior of the bifid tubercles alluded to in *Aglia*), while the four spines upon the 2nd and 3rd thoracic segments are immensely large. All the six spines are thorny. No other spines are shown in the figure, and if present, they must be quite rudimentary. The older larva (fig. 1) has lost all the spines, just as *Aglia*

does at the last ecdysis. In certain species of *Ceratocampa*, figured by Burmeister (Plate XX.), the pair of dorsal spines on each segment are moderately developed, while those upon the 2nd and 3rd thoracic segments, and the caudal horn, are slightly predominant (*Ceratocampa wardii*, *C. principalis*, and *C. argyracantha*, the latter upon Plate XXIII., fig. 7). In others again (*C. imperialis* and *C. penelope*, Plate XX.), the caudal horn and thoracic spines are short and inconspicuous, while the others are very small indeed. In *C. phoronea*, *C. ixion*, and *C. Regalis*, Plate XIX., the thoracic spines and caudal horn are very much developed, the others small. There are several spines on each thoracic segment in these species, but the dorsal pair upon the 2nd and 3rd thoracic segments, corresponding to those upon the 1st and 3rd thoracic segments of *Aglia*, are much the largest. These spines on the 2nd and 3rd thoracic segments of the last-named species (*C. Regalis*) are immensely developed, but not proportionately more so than in *Aglia*. I have to thank Lord Walsingham for kindly sending me Burmeister's beautiful work.

Abbot and Smith, in their 'Natural History of the Rarer Insects of Georgia,' have arranged the moths of the above-mentioned genera, immediately after the *Sphingidæ*, as if to express their ideas as to the mutual affinities. The first moth after the *Sphingidæ* is *Phalæna cecropia*, of which the larva is another good example of the same kind of development. No spines are figured on the 1st thoracic segment; while the caudal horn and the dorsal spines on the 2nd and 3rd thoracic segment are rather larger than the others, which are nevertheless distinct on all abdominal segments anterior to the 8th. In *Phalæna promethea*, also figured by these authors, the five most prominent spines are also coloured differently from the others.

An extremely interesting larva from Lake Tanganyika was kindly sent me by Dr. Sharp. It is probably allied to *Ceratocampa*, or it may be a *Smerinthine* larva, allied to *Lophostethus*. Three strongly-developed spines are present on each side of every segment, from the 2nd thoracic to the 7th abdominal, both inclusive. On the 8th abdominal, the two dorsal spines are fused into a *forked caudal horn*, the only forked spine on the larva, and hence there are only five spines on this segment.

There are six spines on the 9th abdominal as on the segments anterior to the 8th. Minute rudiments of some of the spines are present on the 1st thoracic segment. All the spines are very uniformly developed, those in the dorsal rows being rather larger than the others, especially anteriorly. There is a much smaller spine beneath the inferior long spine on each segment.

The presence of a distinct forked caudal horn, with a complete, uniformly developed, spinous investment is most interesting and suggestive.

The larvæ here alluded to, and many more, make a very perfect transition from the condition found in *Aglia tau*, to that in which the spinous covering is uniformly distributed and uniformly developed. In *Aglia* and many of species of *Ceratocampa*, concentration and specialisation has led to extreme developments at either end of the larva, and diminution elsewhere. It seems to me that *Sphinx* has gone further in the same direction. The uniform spinous covering, certainly present in a rudimentary form in the youngest *Sphinx* larvæ, has become reduced to a far greater extent than in *Aglia*, and many species of *Ceratocampa*, so that at last only the caudal horn remains. Tendencies in the same direction are seen in *Aglia* and *Rhescynthis*, which lose all the spines in the last stage. Other methods of protection are developed—terrifying marks, protective resemblances leading to concealment, &c.,—and the older mode of defence is abandoned, the caudal horn of *Sphingidæ* remaining as a remnant of the former condition.

If this be true, we should expect to find traces of the thoracic spines in certain *Sphingidæ:* we should expect that a remnant of the ancestral condition would be retained in some species. This appears to be the case with the North American genus *Ceratomia*, which is placed next to *Smerinthus*. The larva of *C. quadricornis* is described by T. W. Harris ("Catalogue of North American *Sphingidæ*," 'The American Journal of Science and Arts,' vol. 36, 1839, p. 282) as possessing a pair of short denticulated horns on the 2nd and 3rd thoracic segments, and a long bluish caudal horn. Traces of the other less-developed spines of *Ceratocampa* are also probably present, for he describes "two parallel series of little teeth on the first four segments," and

"a dorsal row of larger teeth extending to the tail." The author evidently recognises the significance of the characters, for he states that "an analogous and still more imposing form is found in the larvæ of the *Phalænæ*, belonging to the genus *Ceratocampa*." The larva is also described by B. Clemens in his "Synopsis of North American Sphinges" ('Journal of the Academy of Natural Science of Philadelphia,' vol. iv., 2nd series, p. 97). This author also places *Ceratomia* next to *Smerinthus*, and speaks of "four thoracic fleshy granulated horns, caudal horn rather short, straight, and roughened" in *C. quadricornis*. This description conveys an impression that the four thoracic horns and the caudal horn belong to one series, an impression not conveyed in Harris's account. Both descriptions refer to the mature larva: it would be most important and interesting to have the ontogeny of this and other species of *Ceratomia* carefully worked out. I trust that some American lepidopterist will shortly undertake this work, or will send me living pupæ of the species, which I believe to be quite common. It is interesting to note that the thoracic spines of *Ceratomia* follow *Ceratocampa* rather than *Aglia*, although the latter is *Sphinx*-like in so many minute details.

There is also the extremely interesting African Smerinthine larva, *Lophostethus Dumolinii*, described from Roland Trimen in Prof. Meldola's Appendix to his translation of Weismann's Essays (*l. c.*, pp. 527—528). Spines are present on all segments except the 1st thoracic. The two dorsal rows of spines are the longest, and the longest of these are on the 3rd thoracic and 1st abdominal segments, thus differing from *Ceratocampa*. The caudal horn is shorter than the dorsal spines, but similar in structure, being covered with prickles. The other rows of spines are also present below the dorsal rows, but much smaller, as in many species of *Ceratocampa*.

The condition of the young larva is most significant. The 1st thoracic segment (or head, but the former is almost certainly intended) possesses a pair of short dorsal spines. The other dorsal spines are much longer and bear prickles. *The dorsal spines of the 2nd and 3rd thoracic segments and the caudal horn are longer than the rest, and the caudal horn longest of all; and all five*

possess forked tips. Hence the young form of this larva combines the characters of *Ceratomia*, *Ceratocampa*, and *Aglia* in the most beautiful manner.

Prof. Meldola informs me that he has long considered that the caudal horn of *Sphingidæ* is to be looked upon as a remnant of a general spinous covering. Wilhelm Muller ("Sudamerikanische Nymphalidenraupen," pages 249—250) identifies it, in the most convincing manner, with the dorsal tubercles upon the 8th abdominal segment of *Saturniadæ* ("*ds*dorn"). The two terminal bristles are the chief bristles No. 1 carried up on the summit of the spine or horn itself.

We have therefore an accumulated body of facts and conclusions which seem to render it certain that the *Sphingidæ* are a specialisation of the group of Saturnian Bombyces, and that the following order represents the nearest affinity, and is an approach towards the expression of genetic relationship.

Sphinx.
Acherontia.
Smerinthus.
Ceratomia.
Lophostethus.
Aglia.
Ceratocampa (*Attacus*).
Saturnia.

The other genera of *Sphingidæ* will precede *Sphinx* as in the usual arrangement; but some of them, especially *Sesia*, may be altered in position, when the ontogenies have been worked out. *Acherontia* also may be modified in position, but not, I think, to any great extent. *Endromis* and the so-called *Bombyx mori* (which Mr. Kirby tells me he has never considered as a *Bombyx*) will also be included between some of the gaps in the above-mentioned list, but their exact position is uncertain until the ontogenies have been worked out from this point of view.

The imaginal condition of the *Sphingidæ*, which come nearest to *Aglia*, &c., is also strongly in favour of the above arrangement. They alone do not feed in the perfect state, and do not fly in the characteristic manner of other hawk-moths: in the strict sense of the word

they are *not* hawk-moths. Their mode of flight, and especially their rudimentary and unused mouth-parts, are further points of affinity to the Saturnians.

It therefore follows that the chief peculiarities of the *Sphingidæ*, as opposed to the main body of Bombyces,—the fact that they feed largely and are greatly specialised in relation to flowers,—are characters which were absent from their Bombyciform ancestors, and are still absent from *Smerinthus*, while they have been re-acquired comparatively recently in the phyletic history of the majority of *Sphingidæ*.

The most natural arrangement would be for the *Sphingidæ* to form the end of one special line of Bombyces, the order being the exact reverse of that given above.

If, however, in view of their size and importance, it be preferred to begin the series of Heterocera with the *Sphingidæ*, the order within the group itself should be the reverse of that usually adopted in descriptive works, and should end with *Smerinthus* and the genera allied to it, and then the Saturnian genera should follow as in the list given above.

I trust that these conclusions will stimulate entomologists to carefully work through the life-histories of other species, so that the complete series may be constructed, and the affinities between the existing species of Bombyces may be expressed in the most satisfactory manner.

4. The cause and meaning of the Sphinx-like attitude.—The extremely marked and characteristic Sphinx attitude assumed by the larvæ of *Aglia*, together with the fact that this attitude is most pronounced in the early stages of this genus and of *Sphingidæ*—when the larvæ habitually rest on the under sides of the leaves—led me to consider whether there might not be some causal relation between the position selected and the attitude assumed. Putting together all the facts, and collecting fresh observations, the following explanation suggested itself to me. In larvæ which assume this attitude the thoracic legs are not employed for the support of the body; hence, when the larvæ cling to a leaf or twig so that the dorsal surface or posterior extremity is lowest, the weight of all parts anterior to the 3rd abdominal segment is only indirectly supported by

means of the claspers. The young larvæ of all species which exhibit this attitude habitually rest on the midrib, or one of the chief lateral veins on the under sides of leaves, and therefore with the dorsal surface downwards. When older the larvæ rest upon twigs, with either a vertical or a horizontal direction: in the former case the posterior extremity is lowest, in the latter the dorsal surface may be either above or below, according as the larva clings to the upper or under side of the twig. When the larva rests on the upper side in a horizontal position, the Sphinx attitude is never strongly marked.

Hence it is clear that in all the younger stages, and for a large part of the last stage, such larvæ are subject to strains which tend to bend the anterior part of the body downwards. Under these circumstances the organism reacts upon the strain, and the muscular body-walls strongly contract upon their fluid contents in such a manner as to produce compensating rigidity, and giving to the body the curve which is characteristic of the attitude. The Sphinx attitude is to be explained as *the combined effect of gravity and of muscular reaction upon the anterior unsupported parts of the body.* The muscular arrangements which are most favourable for counteracting these strains are also made use of in the older larvæ for the maintenance of a feebly-marked Sphinx attitude, when the larva is seated on the upper side of a horizontal twig. The attitude is most strongly marked when the larva is resting on a vertical twig, because gravity tends to draw the anterior part of the body *backwards* as well as *downwards.* These large larvæ habitually rest on vertical twigs with the head uppermost, because the twig itself is approached from its base, and gradually stripped of leaves towards its apex. The essential dependence of the attitude upon gravity is well seen when a vertical twig, with a larva upon it, is carefully bent downwards so that the strain is in the opposite direction, and tends to bend the anterior part forwards instead of backwards: under these circumstances the larva begins to yield to the strain in a few minutes. When the larvæ of *Smerinthus ocellatus* are kept in large numbers, it is common for many of them to suffer from a disease of which the first symptom is a partial failure in the tonic contraction of the body-walls. The anterior part of the body, there-

fore, yields entirely to the influence of gravity, and bends sharply, forming a right angle with the rest of the body when the larva is in a horizontal position on the under side of a twig or leaf, less than a right angle when the larva is vertical. If, however, the larva be touched, the stimulus instantly causes muscular contraction, and the normal *Sphinx* attitude is temporarily assumed. Perfectly healthy larvæ, in a vertical position, may sometimes also be seen to so far yield to the strain that a very extreme form of the attitude is produced, with less than a right angle between the anterior and posterior parts of the body, but I believe that the bend is never sharp except in diseased larvæ. Touching such healthy larvæ also causes them to take the more normal position for a time. It is curious that the term *Sphinx*, employed to describe this attitude, only really applies to the *one* position, which does *not* clearly exhibit its real meaning and significance. The muscular adjustments which are suited to counteract the strains chiefly felt in *other* positions are the cause of the attitude when the larva is in the true position of the Egyptian Sphinx, *viz.*, extended horizontally along the upper side of a twig. But it will be observed that the attitude is never strongly marked under these circumstances. Thus in fig. 5 of the plate illustrating my paper on the ontogeny of *Sphinx ligustri* (Trans. Ent. Soc. Lond., 1885, Plate VII.), the larva is represented in an unnatural position, for I now see that a larva in which this attitude is so pronounced must have been seated on the *under side* of the twig, or more probably on a vertical twig, with the head uppermost. Plate XVII., fig. 5, of the present paper represents the *Sphinx*-like attitude as it is commonly assumed on the *upper side* of a twig. Further support for these conclusions is found in the fact that the attitude does not appear to occur in the larvæ of *Sphinx convolvuli*, which feed on a creeping food-plant.

5. The graphic method of representing the growth of lepidopterous larvæ.—I was led to apply this method to larvæ in order to institute a comparison between the rates of growth in the two English species of *Sphinx*. The fact that *S. convolvuli* is so much smaller than *S. ligustri* at the beginning of the larval ontogeny, and so much larger at the end, seemed very

remarkable, as the species are so closely allied. In Diagram II. (p. 578) the rates of growth in these two larvæ are shown by the graphic method. It must be remembered that the mature *S. convolvuli* certainly attains a much greater length than that indicated by the ordinate VI′. Thus Mr. Buckler describes a full-grown larva as 4 in. in length,—more than one-fourth as long again as the average length of my mature larvæ. As, however, my measurements are the only ones available for the other stages, it is better to retain the length given in the diagram. The curve thus represents the true lengths measured during the life-histories of one set of larvæ. I believe, however, that the lengths of the other stages are about normal, and that the effect of artificial surroundings, or the naturally small size of my larvæ, became manifest in the last stage only. The lengths of the larvæ and the duration of the periods are those given at the end of the account of the ontogeny. The corresponding data for *S. ligustri* are taken from my paper in Trans. Ent. Soc. Lond., 1885, p. 281 *et seq.* The length of the last stage (75·0 mm.) is taken from Mr. Hellins's account of the larva in Mr. Buckler's volume (*l. c.*, p. 111). The length of the larva at the beginning of the 5th stage is estimated at 36·0 mm., as the measurement (33·0 mm.) given in my paper was taken from the larva in the *Sphinx* attitude (*l. c.*, p. 288). The data for *Aglia tau* are to be found in the present paper.

In order to facilitate comparison between the growths of the two *Sphinx* larvæ, the lengths of *S. ligustri* have been marked on the ordinates of *S. convolvuli*, and connected by a dotted line, and conversely those of the latter upon the ordinates of the former. If the duration of the larval stages were the same, then the comparison between the dotted and continuous lines would represent the real relation between the larval growths. I have already given reasons for the belief that the duration of larval life in *S. convolvuli* is abnormally long in this country, and it is therefore possible that the dotted line which crosses the ordinates of *S. ligustri* more nearly represents the normal condition of *S. convolvuli* than the line which represents the observed condition of the latter species.

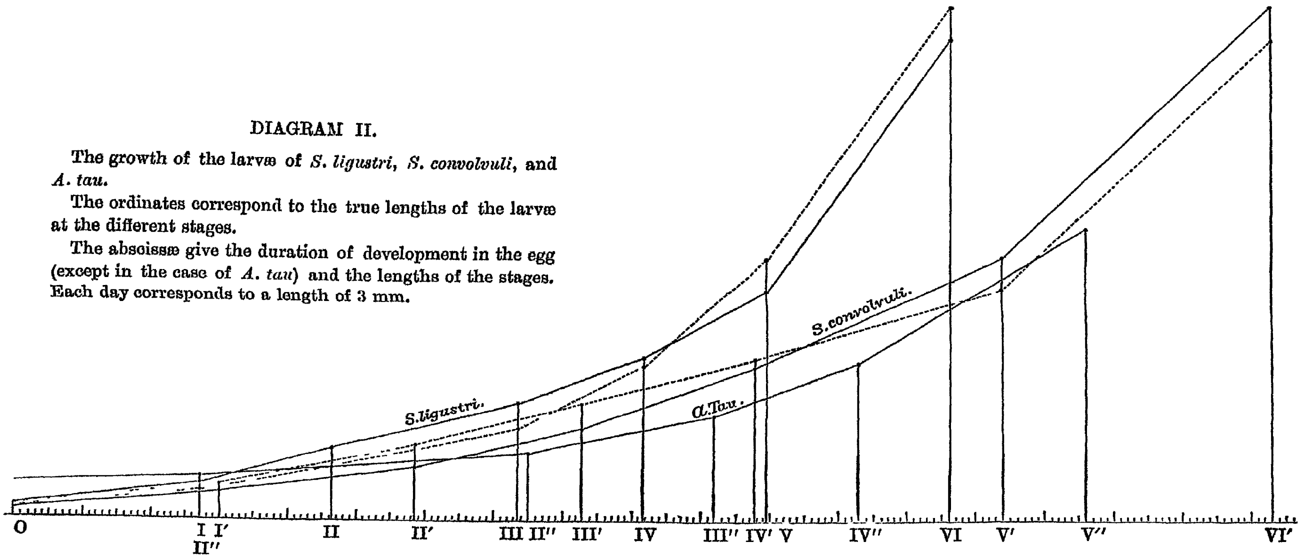
The most remarkable fact shown in the diagram is the manner in which the rate of growth in *S. convolvuli*

DIAGRAM II.

The growth of the larvæ of *S. ligustri*, *S. convolvuli*, and *A. tau*.

The ordinates correspond to the true lengths of the larvæ at the different stages.

The abscissæ give the duration of development in the egg (except in the case of *A. tau*) and the lengths of the stages. Each day corresponds to a length of 3 mm.



O = long axis egg.
I, II″ = length of newly-hatched larvæ of *S. ligustri* and *A. tau*.
I′ = length of newly-hatched larvæ of *S. convolvuli*.

II, II′, II″.	Length of larvæ of *S. ligustri*, *S. convolvuli*, and *A. tau* at end of 1st stage or beginning of 2nd.
III, III′, III″.	„ „ „ „ „ „ „ „ 2nd „ „ 3rd.
IV, IV′, IV″.	„ „ „ „ „ „ „ „ 3rd „ „ 4th.
V, V′, V″.	„ „ „ „ „ „ „ „ 4th „ „ 5th. (The end of ontogeny of *A. tau*.)
VI, VI′.	„ „ *S. ligustri* and *S. convolvuli* at end of 5th stage.

gradually overtakes and passes that of *S. ligustri*. The newly-hatched *S. ligustri* is much larger than the other species, and its rate of growth during the 1st stage is much greater: in the 2nd stage the growth is almost exactly equal: in the 3rd stage *S. convolvuli* rapidly overtakes *S. ligustri*, so that the larvæ are of nearly equal lengths at the end of this stage: soon after the beginning of the 4th stage *S. convolvuli* passes the other larva, and in the last stage the differences are increased to a much greater extent, in the normal condition, although the diagram indicates an equal rate of growth.

Such facts seem to indicate a comparatively recent increase in the size of *S. convolvuli*, an increase which is only manifest in the later stages, and has not yet passed back to the younger larvæ or the egg. In two such closely-allied species the relative sizes at the beginning of ontogeny probably indicate (unless they are explicable as adaptations) the former relative sizes at the end of larval ontogeny, and the relative sizes of pupæ and imagines. And there may be good reasons for a recent alteration in the size of *S. convolvuli*. I have shown that size in itself may be a protection against the smaller enemies of a species (Proc. Zool. Soc., March, 1887, pp. 240, 241). A larva which feeds upon a creeping food-plant comes especially within the reach of insect-eating reptiles and mammals, and it would certainly stand a better chance of escaping these by an increase from a medium to a large size; and this is also true of the imago, which lays eggs on the plant, and emerges from the pupa near to the plant. It is probable that a similar explanation holds in the case of *Acherontia atropos*, and it would be most interesting to obtain measurements of this latter larva in all stages. The fact that other small *Sphingidæ* feed upon low-growing plants is no objection to this argument. Difficulties are met by different species in various ways. There will be a frequent tendency towards reduction in size in order to assist in concealment; but a *large* larva, which, by a change of food-plant, or a change in the habit of its food-plant, was brought within reach of a large number of the smaller insect-eating vertebrates, would sometimes tend to seek protection in the opposite manner; and the diagram strongly supports the supposition that such changes have actually taken place in *S. convolvuli*.

Further support is given by the small size of this species as found in Madeira and the Canaries. We may have the ancestral size preserved unchanged in these islands, or reversion may have taken place. The fact that other species do not seem to be similarly reduced in size is in favour of the former alternative. Careful investigation of the conditions under which the larvæ exist in these islands would doubtless show why they can there maintain the smaller size without danger, although they cannot do so in other places. In the meantime the following facts deserve attention:— the only insect-eating vertebrates in these islands are birds and lizards: in Madeira there is only one small species of lizard,—so small that the mature larva, pupa, and imago would certainly be sufficiently protected by the size which is usual in the island. Furthermore, these lizards, and the more numerous and larger species of the Canaries, have become largely frugivorous,—an almost certain result of the insufficiency of insect-food. It is therefore probable that such lizards, having learnt to eat other food, are not, like most of these reptiles in other places, inveterate enemies of all insect-life, although it is probable that they still eat a great many insects. The kestrels in these islands also eat large numbers of insects. I saw the crop of one of these birds which had been shot in Madeira: it contained hundreds of larvæ of some species of *Noctua*, a larva which is very common among the roots of the grass on the higher parts of the island. There was also a small lizard in the crop. The larvæ did not approach the size attained by *S. convolvuli* in the island.

These conclusions may be met by the objection that the larvæ must *pass through* all the smaller sizes in order to become mature. Of course this is true; but a larva which is protected by size, in addition to concealment, during part of its life, may gain advantage over a larva which depends upon the latter method alone for the whole of its life. Again, size would be especially advantageous in the critical time during which the larva is wandering about before burying, and also in the imaginal, and, perhaps to a small extent, in the pupal stage.

There are also some other interesting conclusions to be reached by a study of the diagram.

The gradually increasing rate of growth in the successive stages is seen in the increasing steepness

of the curve of all three larvæ. There is only one exception to this: the unusual rate of growth during the 1st stage of *S. ligustri.*

The extraordinary length and small amount of growth during the 1st stage of *A. tau* is very remarkable, but this is largely accounted for by the immense protraction of the resting-period before the 1st ecdysis in this species. The fact that the larva of this species is at first so much longer than the other two, is not open to the interpretation which was given in the case of the two species of *Sphinx*, because the affinity between the former and the two latter species is so much more distant. The length of the egg of *A. tau* and the duration of development could not be indicated on the diagram. If, however, the line be prolonged to the left of ordinate I.″ for a distance of 93 mm., the relative length of development will be expressed, while the line will be found to come within 2·5 mm. of the abscissa line (also prolonged to the left)—a distance corresponding to the length of the egg.

It is to be hoped that data may be available for representing the growth of many species of larvæ and especially the *Sphingidæ*, by this method.

6. The means of defence adopted by the larva of Stauropus fagi.—Hermann Muller pointed out long ago that the irritated larva assumes a spider-like attitude for the purpose of alarming its enemies. Having the opportunity of watching a number of these larvæ last summer, I am able to add a few more details to H. Müller's description. I am indebted to my friend Prof. Meldola for directing my attention to H. Müller's paper in 'Kosmos,' Nov., 1879, p. 114.

When at rest and unalarmed the larva is certainly very difficult to detect: it is protected by resembling a withered beech-leaf, irregularly curled up. The body, which is often held asymmetrically, represents the leaf, being about the appropriate diameter, colour, and length. The two caudal processes, modified from the last pair of claspers, are always applied together during rest, and thus, looking like a single process, they represent the leaf-stalk. The 2nd and 3rd pairs of thoracic legs are folded at the middle of their length, and hang down in a bunch, resembling, in the most beautiful manner, a

bunch of the brown scales (the stipules of the foliage-leaves) which enclose the buds of the beech, and hang down after the latter are unfolded. These persistent brown scales, dependent from the branches in little clusters, are very characteristic of the beech. Each scale is rolled up, so that its edges are nearly, but *not quite*, in contact at the base and along the whole length, while they pass into each other at the tip. Hence, when looked at from the side, a chink is seen, leading into the hollow of the fold; the chink disappears at the tip, and ceases to be recognisable even a little before the tip is reached. A very similar effect is produced in the case of the four long thoracic legs, for each of them is bent upon itself in the middle, so that there is, of course, a furrow between the two halves, which disappears at the bend itself. The point where the furrow ceases is, in both leg and scale, at the dependent end of the structure. The legs are of the appropriate length and colour for this purpose, and I made some special observations to prove that their number is also an additional aid to protection. The numbers of scales in nine clusters upon a single beech-bough were as follows:—5 (4 dependent, 1 raised), 8 (4 dependent, 4 raised), 4 dependent, 3, 4, 3, 2, 1, 2, all dependent. Thus nearly all the scales were dependent, and four was by far the commonest number, if we remember that the dependent scales in the first two clusters would have the appearance of separate bunches. In another bough many of the scales were irregular, *viz.*, neither dependent nor raised, but at various intermediate positions. The first three clusters were irregular, the numbers in succeeding clusters being as follows:—4 dependent, 1 irregular, 1 irregular, 6 (5 dependent, 1 raised), 3, 1, 7, 5, 1, 6, all dependent, 2 raised; then followed two irregular bunches with very small scales, 4 dependent, 6 (4 dependent, 2 raised), 4 dependent. It must be remembered that these numbers represent the condition of the boughs in the middle of September, 1887, and that much of the irregularity may be due to the loss of some of the scales. The larvæ feed in August and often in to September, so that the numbers would nearly represent the actual condition of their surroundings in that year. The brown scales do not persist for long, but it is common for fresh buds to open late in

the year, at a time when the larvæ are feeding. This was the case in 1887, when these observations were made. It is clear from these examples that the bunch of thoracic legs, dependent from the anterior end of the larva, gains in protective value by being made up of the *four* elongated legs, instead of the normal number —six. But it will be shown that this very arrangement has also a special value in the terrifying attitude—a good example of the remarkable way in which larvæ may be perfectly adapted to entirely different methods of protection. The extreme development of four thoracic legs has a most important meaning in the spider-like position, but, while entirely adequate for this purpose, the legs have been kept at a length which, *when halved by the fold* in the resting position, is most appropriate for the protective resemblance to the scales. For quite other purposes the first pair of legs are not lengthened like the other two, and this also causes resemblance to a bunch containing the commonest number of scales.

There are also one or two additional points to be noted in the terrifying attitude. The anterior unlengthened thoracic legs are held apart, and certainly suggest the jaws of a spider-like animal. In the case of *S. fagi*, as in other examples of this mode of protection, the points seized upon are the ones which most influence the imagination, and these are exaggerated for the sake of effect. Thus the supposed jaws are larger and more widely gaping than would be natural, and yet additional effect is thus gained. Then quite novel touches are added with the same object. Thus the posterior abdominal segments are turned so far over the head that the two caudal appendages project over it, and they are at the same time rendered divergent. They thus occupy the appropriate position for a pair of antennæ, which, indeed, they suggest most strongly; and they add an ideal finish to the suggested monster, which is, indeed, exactly like nothing upon earth, but which is, nevertheless, most effective in its appeal to the imagination. The four elongated legs are well known to be extended widely, and to quiver in the most terrific manner, as if preparing to seize the enemy. A suggestion is here, doubtless, made of the legs which a spider uses in attack; the other legs by which these animals gain support are

less conspicuous, do not appeal to the imagination, and are altogether unrepresented in the larva. The ventral surface of the posterior abdominal segments, of course becomes, in the terrifying attitude, the dorsal surface of the abdomen of the supposed spider, and it is coloured in the most appropriate manner for such an end; and, furthermore, has a suggestion of plumpness and convexity which greatly assists the resemblance. It must be admitted, however, that the supposed abdomen is somewhat deficient in breadth, although I do not think that anything is lost, inasmuch as I have already suggested that the larva does not exactly resemble any spider, but only an ideal monster which embodies all the most alarming points in a spider's organisation. If the larva be greatly irritated, the posterior abdominal segments are gently moved over a short distance from side to side, and, of course, with them the antenna-like processes. This movement also adds to the general effect.

It may be urged in criticism of these remarks and conclusions, that I am attributing to the enemies of the larva, powers of imagination hardly possessed by man himself. But I think we have actual evidence that, at any rate, the vertebrate enemies of insects have the keenest imagination, at least as regards an object, which even distantly suggests any of the dangers which *naturally* surround them. And doubtless this imaginative power is a most valuable safeguard to them. Weismann's well-known experiments with the larva of *Chærocampa elpenor* (subsequently confirmed by Lady Verney), clearly showed the fear felt by birds for an object which *looked as if it might be* dangerous, although it exactly resembled nothing that they had previously seen. I have repeated these experiments with a large lizard (*Lacerta viridis*), and found precisely the same results; the lizard only attacked the larva with the greatest care, and after many preliminary attempts. As soon as the larva was found to be harmless, it was devoured with the greatest relish. It is hardly likely that the various appeals to the imagination detailed above, can be meant for the insect enemies of *Stauropus fagi;* but the fact that the larva does suggest the appearance of a spider, must probably serve to terrify them. This is rendered very probable by H. Müller's observation that ichneumons are rarely seen

in the webs of spiders: hence it appears that they keep out of the way of these animals. And we have some grounds for the belief that the additional refinements may not be entirely lost upon the insect enemies. At any rate, I have shown that if we are to accept the theory of sexual selection (and no other theory has yet been suggested which can serve as an adequate explanation of all the facts of the case), the comparison between the colours and patterns which are due to this principle, and those which are due to the various defensive needs of the insect, leads us to the inevitable conclusion that "our own sense of what is beautiful, entirely coincides with that of an insect" (See Proc. Zool. Soc. Lond., March, 1887, p. 216). I should not, however, have ventured to speak so plainly of the meaning of the various details in the defensive attitude of the larva, if I had not been able to rely upon the best support attainable—the support yielded by direct experiment.

In the first place, my interpretations were obtained from the careful study of the living larva—at rest and after various degrees of irritation. The terrifying attitude is often imperfectly assumed at first, and the full meaning of the details is only seen after continued irritation; but at the same time this very fact carries conviction with it. The larva at first relies on the effect of its outstretched quivering legs, and the posterior part of the body is not usually completely doubled over. As the irritation is repeated and increased, the larva gradually adds the various details which go to make up the terrifying attitude in its most perfect and elaborate form.

In the second place, I offered the larva to two of its vertebrate enemies, and actually witnessed the effect produced upon the latter. The larva was placed upon a table, and was made to assume the terrifying attitude in a very complete manner. The attention of a marmoset was then directed to the larva, and although the former is excessively fond of insects, and seizes caterpillars with greatest avidity, it was much impressed by the alarming sight, and only ventured to attack the larva after the most careful examination, and even then in the most cautious manner. Meeting with no resistance, the larva was soon devoured and greatly relished. I then tried a similar experiment with a lizard, and the same results

were witnessed, although not to an equal extent. This is, however, what we should expect from the comparative intelligence of the two animals. Hence the interpretation of the attitude offered by H. Muller, and further elaborated in the present paper, may be said to rest upon a basis of experimental proof (See 'Report of the British Association,' 1887, p. 764, for a short account of these experiments, and others of the same kind).

The final means of protection possessed by the larva was also discovered by H. Muller, and it is directed entirely against insect enemies. On each of the 1st and 2nd abdominal segments, below and rather behind the spiracles, is a shallow pouch-like involution of an intensely black colour. Each black area is entirely concealed during rest by a triangular flap, formed as an outgrowth of the lower margin of the area. The flap is directed upwards and completely covers the area, but upon irritation it is depressed, and the pouch itself is at the same time rendered shallower by partial eversion, so that the black patches become very conspicuous (see Plate XVII., fig. 7, × 4·5, where the larva is represented with the flaps depressed, and the patches visible). It is in every way probable that, as H. Muller has suggested, these black marks are intended to imitate ichneumon stings, or at any rate the results of a struggle with some insect enemy, in which the larva has been wounded. The marks evidently suggest the scars made by some *insect*, because the attacks of other enemies are nearly always immediately fatal. The larvæ are certainly often wounded incidentally during the oviposition of parasitic Hymenoptera, the wounds being caused by the sharp curved claws of the latter, which must hold very tightly in order to render oviposition possible during the struggles of the larva. I have also seen an ichneumon (*Paniscus*) bite a larva most savagely, at a time when it may have been attempting to lay eggs; but this is uncertain. (See Trans. Ent. Soc., Lond., 1887. p. 307). In the paragraph just referred to, I remarked that I had never seen scars upon the larvæ of *Cerura vinula*, such as would indicate that wounds were incidentally inflicted. Since then I have observed this on more than one occasion. I have seen so large a scar in the neighbourhood of the eggs of *Paniscus* affixed to the larva in question, that it seemed clear that the wound had been inflicted by the mandibles

of the Hymenopteron, and was not a mere scratch from one of its claws. The blood of the lepidopterous larva forms a black clot, so that wounds are nearly always black until after the next change of skin. On these accounts I think it is clear that the black marks exposed by the larva are calculated to suggest to the approaching enemy that the individual in question is already occupied. This interpretation will receive further support in the next section, in an instance of the use of the same colour by the ichneumon itself for an entirely analogous purpose.

The black marks of *S. fagi* are also very interesting from a morphological point of view. In common with the terrifying marks of *A. tau*, previously described, they have the structure of eversible glands, which are so common in larvæ, and of which I have described many in earlier papers. It is *possible* that this may have been their original significance, but whether this be so or not, I think it is almost certain that they have played the part of terrifying marks in some different form of alarming attitude formerly adopted by the larva. Their exact similarity to the marks of *A. tau* is in favour of this view, for there is no doubt about the meaning of the character in the latter species. The only difference between the two larvæ is the presence of the mark on the 1st and 2nd abdominal segments in *Stauropus*, and on the 1st abdominal only in *Aglia*. Other reasons for this opinion are to be found in the facts that the marks are still very large for their purpose (inasmuch as the scars are rarely of such a size), and that the opening and closing apparatus still remains in perfect working order. The latter has a definite meaning for a terrifying mark, but it is difficult to see how it can have been developed in connexion with the imitation of a scar, which is, of course, persistent. There is no difficulty, however, in understanding why it should have been *retained* in connexion with such unnaturally large scars, for continued irritation of the larva shows that this is one of the last resources adopted when the enemy has already discovered it. The continued display of such large marks would certainly interfere with the protective resemblance in the passive resting-condition.

The same objection would hardly apply to a mark which resembled a scar of the commonest size, *viz.*, such

as would follow from the puncture through which the egg is inserted by an ichneumon's ovipositor. If, therefore, the marking originally possessed its present meaning, it is difficult to see why it should not be of the appropriate size—a size which would not need to be concealed during the protective attitude.

The larva of *Stauropus fagi* therefore bristles with defensive structures and methods. When at rest it is concealed by a combination of the most beautiful protective resemblances to the commonest objects which are characteristic of its food-plant. Attacked, it defends itself by a terrifying posture, which is made up of many distinct and highly elaborate features, all contributing to this one end. Further attacked by an insect-enemy, it reveals marks which suggest that it is of no interest to its enemy, for another parasite is already in possession.

It may not unreasonably be objected that the larva is far from common, and that the small efficiency of the defensive measures throws doubt upon their interpretation. I have, however, already answered this objection in the case of the larva of *Cerura vinula* (Trans. Ent. Soc. Lond., 1886. pp. 158, 159). I argued then as I do now that such an "exceptional standard of defence was only attained by an exceptional need." The means of defence have been the response on the part of the organism to the increasing attacks of enemies; and the latter, on their part, have met the response by increasing cunning or boldness.

7. The meaning of the black colour of the eggs of Paniscus cephalotes.—The shining black ova of this parasitic species are well known to every collector of the larva of *Cerura vinula*, for they are most conspicuous against the green background formed by the larval colour. Although the ova are partially hidden in the inter-segmental furrows, they are revealed at every movement of the larva, while some of them can usually be seen at all times. When Prof. Weismann was staying with me in the summer of 1887, I showed him one of these larvæ with the eggs affixed. This led to a discussion as to the meaning of the colour, in the course of which we both independently arrived at what I believe to be the correct interpretation, *viz.*, that the colour is adapted

to serve as a warning to other insect parasites belonging to the same and other species, that the larva is already occupied. It is most interesting to note that the colour is such as to suggest that the larva contains the eggs of some *internal* parasite, for the black eggs very much resemble the small black scars which are produced by oviposition. Thus the species which lay eggs *within* the body of the larva are warned off, as well as those which lay external eggs. In one case I bred a single dipterous imago from a larva of *Cerura vinula*, which had been also attacked by *Paniscus*. But the time at which the former made its appearance seemed to indicate that the dipteron had laid its eggs *before* the hymenopteron.

8. The defensive value of "tussocks," and the associated black intersegmental markings.—A "tussock" may be defined as a tuft of fine hairs, very closely placed, and of approximately equal length, so that the structure is flat-topped. Microscopic examination shows that the constituent hairs bristle with minute lateral branches (in *Orgyia pudibunda* and *O. antiqua*, and probably in other species also). It is, therefore, clear that they would be extremely unpleasant if brought into contact with the tender skin of the mouth, and the experiments described below prove that this is the case. At the same time the hairs are so closely packed, and the "tussock" appears to be so dense and continuous, that it does not seem to be made of hairs at all, but rather to be a projection from the dorsal surface of the larva, and a most feasible part for an enemy to seize upon. If seized, the fine hairs come out in immense numbers in the mouth of the enemy, and produce such an effect that the larva escapes unhurt.

The following notes show that the "tussocks" are held in an especially conspicuous manner when the larva is irritated, while the black markings are also revealed, and assist by rendering the tussocks more obvious, and by giving an appearance of increased projection.

The larva of *O. pudibunda* possesses a large black intersegmental semilunar mark, between each of the four "tussocks," and a small one behind the last of these. The black marks are all shown to their full extent when the larva rolls into a ring. When the larva

is at rest on a straight surface, but little of the first mark can be seen, and hardly any of the others, while the four tussocks appear to be continuous. In walking, the first mark becomes more distinct, and a little of the others can be seen. If the larva be slightly irritated by gently blowing upon it, or by tapping the surface on which it is crawling, it stops instantly; the head is tucked in, so that its anterior surface becomes horizontal, while the dorsal surface of the anterior segments forms a curved outline. In consequence of this attitude, the first black mark becomes very large and conspicuous, and the second mark also, although not to an equal extent. The two anterior "tussocks" are separated, while the two posterior are approximated, and appear like a single structure. In this way the three apparent tussocks (counting the two posterior as one) become extremely prominent. The attitude is soon abandoned if the larva is not further irritated, but if the irritation is more violent (such as that produced by brushing the larva with a leaf), it is maintained for a comparatively long time. If the irritation be still more violent the larva falls and rolls into a ring, and then the tussocks,—completely separated and thrown up by the black surface around them—become *the* feature of the larva; equally effective in affording an apparent opportunity for the inexperienced enemy, and in aiding the memory of those which are more experienced.

In *O. antiqua* the same object is achieved by segmental rather than intersegmental dark markings, apparently a modification of a broad black dorsal band. The habits of these larvæ when irritated are exactly like those of *O. pudibunda*, the two anterior tussocks being separated, the others approximated, although they are sometimes separated in this species.

This interpretation is *entirely* due to experiment. A larva of *O. antiqua* was introduced into a lizard's cage, and when attacked, instantly assumed the defensive attitude. An unwary lizard seized the apparently feasible part of the larva; most of the "tussock" came out in its mouth, and the lizard seemed greatly troubled by the fine hairs, and did not touch the larva again.

On another occasion a full-grown larva of *O. pudibunda* was offered to a hungry adult *Lacerta viridis*. The lizard evidently knew the danger, and kept trying to

find some part of the larva which could be seized with safety. The larva remained motionless in the defensive position during the whole process, which lasted for some minutes. In this position the protection was very remarkable, the body bristling everywhere with sharp, stiff spines, except in the region of the tussocks. This experienced lizard finally seized the larva on the dorsal surface a long way behind the tussocks, evidently preferring the bristles. Although killed, the larva was not swallowed, and it had only been seized after many attempts and the closest examination. It is quite clear that the hairy covering would have saved it from any except a very hungry enemy.

9. The meaning of the peculiar method of progression in the larvæ of Cochliopodidæ.—It is well known that these larvæ rest on the upper surface of the leaves of their food-plants, and that the body is inflated, so that a peculiar dome-like shape is produced. The larvæ are thus quite unlike caterpillars, and may suggest the appearance of some kind of gall on the surface of the leaf, and there is also a certain degree of resemblance to the pupæ of *Coccinellidæ*. It is probable that careful investigation of the larvæ in their natural surroundings, will, perhaps, reveal the object which is resembled for purposes of protection, although it is possible that the object is not now to be found in our country. George Tate, who supplied me with larvæ of *Heterogenea asellus*, could not remember any object which they resembled, but special attention must be directed to the point before we can accept this testimony as final. The terrifying appearance of the larval *Chærocampa elpenor* is founded upon that of a cobra-like serpent, which is quite unlike any of our native reptiles. The latter larva, nevertheless, gains protection because of the instinctive fear of anything snake-like felt by its enemies ; and the *Cochliopodidæ* certainly gain protection by assuming a form which is quite unlike that of a caterpillar, and does not suggest the appearance of the food of any insect-eating vertebrate. When the movements of these larvæ (*H. asellus*) lead to their detection, they are greatly relished by lizards.

If, then, protection is gained by the remarkable attitude assumed upon the upper surface of the leaf, the

meaning of the method of locomotion becomes clear. Lepidopterous larvæ can walk on the under surface of leaves because of the presence of projecting veins, but the upper surface is smooth, and affords no foothold. Hence larvæ often spin a foothold upon the upper surface (young *Cerura vinula*, &c.), while the vast majority rest upon the under surface; although this is chiefly due to the more perfect concealment which is thus rendered possible. There is, however, a method by which small larvæ, which weigh little, can walk freely over the smooth upper side of a leaf: that is by the substitution of adherence by a sticky surface, for adherence by clasping. The motion of the larva is brought about by the same movements in both cases; the larval body, or part of it, is thrown into undulations, which bring the anterior clasping legs in the one case, and the anterior part of the sticky surface in the other, within reach of new parts of the object over which the larva is walking; while the posterior claspers, and the posterior part of the sticky surface are simultaneously withdrawn from a corresponding length of the object. The motion being thus essentially the same, the conversion of the one method into the other would offer little difficulty. The larvæ, doubtless, first walked with adhesive claspers, and these would gradually become shorter and broader, thus yielding increased support by extending the area by means of which they adhered. Finally, the claspers would be altogether lost, and the whole of the ventral surface, from which they formerly projected, would take part in locomotion.

Such is a probable history of this method of progression, but its use appears to be beyond doubt: it is to enable the larvæ to move freely over the smooth upper surface of the leaves, and thus to assume their characteristic position.

My only experience of the larva of *Limacodes testudo* is founded on an examination of the prepared specimens in the collection which Lord Walsingham has generously presented to the Natural History Museum. There seems little doubt, however, that the larvæ are essentially similar in the points here alluded to.

10. The protective resemblances of the larvæ of Geometra papilionaria.—The "seasonal adaptation" of

the larvæ of this and other species has already been pointed out by Prof. R. Meldola (Proc. Zool. Soc., 1873, p. 155, and editorial notes to the translation of Weismann's Essay, 'On the Origin of the markings of Caterpillars,' p. 305). In the former paper the author calls attention to the interesting fact that the young larvæ are brown, and remain brown during hybernation, when the trees are bare, while many of them become green when older, after the leaves have expanded in spring.

A purely accidental observation has enabled me to show that the younger larvæ possess the power of adjusting the shade of their brown colour to that of the twigs of their food-plant. In the autumn of 1887 a number of these larvæ, which had been reared from ova, were placed in two muslin bags, tied upon different branches of the same birch-tree. The larvæ were examined on May 1st, 1888. In one bag 27 larvæ were found, in the other 4, while 4 larvæ were found upon the tree, having evidently escaped from the second bag. The 8 larvæ were *much lighter* in colour than the others, the difference being independently noticed by my wife and myself. Examination of the twigs which had been enclosed in the bags at once showed that their colour corresponded with that of the larvæ. The bag containing the 8 larvæ had been tied on to a part of the tree which had been largely pruned earlier in the year, and the enclosed twigs were young and comparatively light-coloured. The necessity for such protection is especially important in this species during hybernation, when its enemies are often compelled by hunger to search for food in the most careful manner.

After hybernation the larvæ grow rapidly, and in the last stage become dimorphic, some of them being green and some brown. After experimenting for two seasons I failed to obtain evidence of any susceptibility on the part of the larvæ during this stage: dark surroundings did not make a larger proportion of larvæ brown, nor did green surroundings make a larger proportion green. It will be shown below that these colours are certainly hereditary, like those of the *Ephyridæ*.

The larvæ in the last stage are protected by their close resemblance to catkins. They feed upon catkin-bearing trees, hazel and birch. The brown posterior end of the body exactly suggests the brown scale at the

base of a catkin; the short stout body of the larva is of the appropriate shape and size, and is held in the appropriate attitude; the edges of the segments, seen in profile, project a little, and are very distinct all round the larva, thus suggesting the overlapping scales of the catkin; and the resemblance is heightened by the projecting edges being tipped here and there with brown, in the green larvæ. The brown larvæ similarly resemble the older brown catkins.

There is some evidence for the appearance of these varieties at slightly different times, corresponding to changes in the colour of the catkins, but confirmation is needed before this can be accepted as proved. Of 12 larvæ sent me, in the spring of 1887, by Mr. W. H. Harwood, about half were green, and the rest brown: the former pupated much earlier, while the latter lived on until the birch-catkins were brown, and then died before pupation. The evidence suggests that observations should be directed to this point, and that large numbers of larvæ should be employed. Unfortunately my experience this year (1888) did not much help matters, for there was only a single brown larva, and in this case no difference was observed between the times of maturity in the two varieties. Mr. Harwood informs me that he has not observed such differences, but that he believes the larvæ on hazel are somewhat different in appearance from those on birch. My own experience is limited to the latter food-plant.

The protective methods of this larva seem to be very remarkable, and to call for further observation.

11. A PROOF OF THE PROTECTIVE VALUE OF DIMORPHISM IN LARVÆ.—Whatever be the value of the dimorphism of the older larvæ of *Geometra papilionaria*, it is quite certain that this mode of appearance is useful to the species. From the pupæ obtained from green larvæ in 1887, moths were bred and fertile eggs obtained: about 30 young larvæ grew up to maturity, and of these only a single one was a brown variety. If, therefore, either of these varieties had any advantage over the other, and continued to have advantage, whatever the proportionate numbers might be, it is quite clear that such variety would very soon be the only one. The fact that both varieties exist, demonstrates that the dimorphism is

advantageous to the species,—that each variety becomes of especial advantage when a certain proportion between the numbers of the two forms is reached. Whatever be the advantage afforded,—whether it be that suggested in an earlier paper (Trans. Ent. Soc. Lond., 1884, pp. 50—56), or because of a difference in the times at which the two varieties respectively appear,—it is perfectly certain that the advantage is real. The breeding experiment with moths from larvæ of one colour clearly shows that if either form were less useful, it would be exterminated in a very few seasons.

12. The protective resemblance of the pupa of Apatura iris.—During the past summer (1888) I succeeded in obtaining a single fine female pupa of this species from larvæ sent me in the autumn of 1887, by George Tate.

The pupa was suspended from a sallow-leaf, and it resembled a leaf in the most perfect manner. The twig of sallow was on several occasions offered to friends in order to ascertain whether they could detect the pupa, and it was almost invariably overlooked. Even when the pupa was pointed out, the observer frequently failed to see any difference between it and a leaf.

The most extraordinary thing about this resemblance was the leaf-like impression of *flatness* conveyed by a pupa which was in reality very far from flat. Thus the length of the pupa was 30·5 mm.; the greatest breadth (dorso-ventral diameter), 11·5 mm.; the greatest thickness (from side to side), 8·5 mm. The following notes were taken July 12th, 1888:—

The midrib of the supposed leaf is represented by a white line along the upper wing, corresponding to its upper edge posteriorly, but below the true edge anteriorly: in the latter region the midrib is represented by a ridge (corresponding to the costal margin of the future imaginal fore wing), which extends along the (pupal) wing horizontally, and meets the antenna obliquely at the junction of the meso- and prothorax. Posteriorly to the upper wing the line crosses the exposed narrow strip of the hind wing, obliquely, on its way to the abdominal segments, over which it is continued backwards as a white stripe immediately above

the spiracles. On the dorsal side of the midrib the lateral veining of a leaf is represented by seven oblique stripes, sloping as in most *Sphinx* larvæ, and situated on the first seven abdominal segments, the stripes being very small and slight on the 1st and 7th segments, and especially long and distinct on the 2nd, 3rd, and 4th. The effect is aided by a deepening of the green ground colour below, and (especially) above these stripes. The increased depth of colour is caused by the relative absence of white dots in this position. On the ventral side of the midrib the wing-veining and the obliquely-directed antenna assist in the general effect by producing a subdued appearance of leaf venation, although the slope is in the wrong direction.

The shape is also modified in a very interesting manner. Dorsally the pupa is flat and greatly compressed, the sides meeting in a thin sharp dorsal ridge extending from the posterior edge of the 9th abdominal segment (close to the part which bears the hooks by which the pupa is suspended) to the anterior edge of the 3rd abdominal. Immediately anterior to this point, at the posterior edge of the 2nd abdominal segment, the single ridge divides into two ridges, which at first form a very acute angle with each other. Along the centre of the furrow between them there is a distinct, although slight, trace of a median ridge. The two ridges pass anteriorly, gradually diverging, to end at the apices of the two divergent horns, which form the anterior termination of the pupa.

Partly in consequence of this conformation, and partly because of the general shape, the slope on the dorsal side of the midrib, anterior to the 3rd abdominal segment, is very considerable, for the pupa does not come to a thin edge, and is very far from flat at this part. And the same is also true for the whole length of the ventral side of the pupa.

But exactly in these places, where the obvious thickness would destroy the resemblance to a leaf, the whole effect of the roundness is neutralised by the increased *lightness* of these parts—a lightness which is so disposed as to just compensate for the shadow by which alone we judge of the roundness of small objects. (Much larger objects can be judged of by the change of focus, which becomes necessary as their near or distant parts are

observed.) In shading the drawing of an object so as to represent roundness, the shade is made to become gradually less and less deep as the tangential planes represented come nearer and nearer to a right angle with the axis of vision. So here, the converse of shading, —the whiteness neutralising the shadow which shading is intended to represent,—dies off gradually as the midrib is approached.

The whiteness is produced by the relative abundance of white dots and a fine white marbling of the surface which is present everywhere, mingled with the green. The effect is, in fact, produced by a process exactly analogous to stippling.

By this beautiful and simple method a pupa, which is 8·5 mm. from side to side in its thickest part, appears flat, and offers the most remarkable resemblance to a leaf which is a small fraction of 1 mm. in thickness.

13. THE DEFENSIVE SECRETION OF THE LARVA OF CRŒSUS VARUS.—The secretion of the ventral glands is distinctly acid to litmus paper. The smell caused by eversion of the glands after irritation, is said to be "sour, like bruised sorrel-leaves." It therefore seems clear that the defensive substance is a volatile acid, but the small size of the larvæ renders any further determination of its nature extremely difficult.

14. THE GEOMETRIFORM STRUCTURE AND ATTITUDES OF EUCLIDIA MI.—A very complete account of the Geometriform structure of young *Noctua* larvæ, and of its bearing upon classification, was written by Professor Meldola ('Trans. of the Epping Forest and County of Essex Naturalists' Field Club,' June, 1881). The object of this note is to call attention to certain peculiar points in the Geometriform movements of the young larvæ of the genus *Euclidia*, and to introduce a figure of the young larva of *E. mi*, in the 1st stage, in the Geometriform attitude (Plate XVII., fig. 8, × 24·5). When I first saw the young larvæ of this latter species, I felt sure that they were Geometers, and yet I was struck by the extraordinary activity with which the larvæ whipped about the anterior part of the body several times between each stride, which was taken with extreme rapidity. I have never seen these movements con-

ducted with anything like the same energy by a true Geometer. When disturbed the larvæ contract into a curious irregular zigzag, in one plane, and remain motionless for some considerable time. This attitude is not unlike that assumed by many young Geometers under similar circumstances. I have also noticed the same movements and the same attitude in the young *Euclidia glyphica* during the past summer. A careful drawing was made of the young larva of *E. mi*, after having been fed for a few days in the 1st stage, and is represented in fig. 8. The absence of the 1st and 2nd pairs of claspers is distinct, and the whole appearance strongly suggests that of a Geometer. The chief bristles and tubercles are very clearly seen, and possess a very typical arrangement.

15. THE DETERMINATION OF SEX IN CERTAIN LIVING LEPIDOPTEROUS LARVÆ.—It has long been known that the essential reproductive glands are to some extent differentiated in the larval state. The changes undergone in this and the succeeding stages are beautifully represented in the plates of Herold's work on the development of *Pieris brassicæ* ('Entwickelungsgeschichte der Schmetterlinge,' 1815).

The testes and ovaries occupy similar positions relatively to the segments of the larva, being found beneath the skin of the 5th abdominal segment, as paired bodies, placed one on each side of the dorsal vessel, just above the digestive tract. The testes form two distinct reniform or lobate masses, while the ovaries have the form of two relatively minute and somewhat twisted tubes. In addition to this, the testes are generally highly coloured, being very commonly yellow or brown, and sometimes even bright red. Hence it follows that these organs can be easily seen beneath the skin of all fairly transparent larvæ, such as most of the Micro-Lepidoptera. By careful examination they can often be made out in moderately transparent Geometer, *Noctua*, and also other larvæ. The ovaries, on the other hand, can only be doubtfully seen in the most transparent larvæ with the aid of a lens. Knowing the anatomical position and structure of the organs, I felt sure that the yellow bodies I had so often seen in the larvæ of Tortrices must be the testes; but, before calling attention

to this easy means of distinguishing the sexes, I wanted to test my conclusions by experiment.

Mr. Sidney T. Klein brought a large number of the larvæ of *Ephestia kuhmiella* to one of our meetings in the autumn of 1887. I saw that the supposed testes were very distinct, being of a dark brown colour in these larvæ. Mr. Klein kindly gave me a large number of the larvæ, and from these I selected a considerable number with, and about an equal number without, the brown organs. They were separated, and eventually males were alone produced from the former and females from the latter, so there was no doubt about the validity of the conclusion.

This fact will doubtless be of use to entomologists in breeding experiments with certain species. The appearance of the testes of the larval *E. kühmiella*, from above and from the side, is shown in Plate XVII., figs. 10 and 9 (both × 9). It will, however, be found that the organs are often somewhat asymmetrical, one being rather behind the other. In the movements of the larva the skin glides backwards and forwards over them to a very considerable extent, producing a very peculiar and characteristic appearance. The testes in fig. 10 are rather more separated than in the normal larva, owing to the application of slight pressure.

The presence of these bodies must have been observed by every entomologist; while every morphologist knows that the testes occupy such a position, although unaware that the organs are visible in many living larvæ. The object of this note is to bring together the knowledge obtained by two different classes of observers.

Explanation of Plates XV., XVI., & XVII.

Illustrating Mr. E. B. Poulton's paper, 'Notes in 1887 upon lepidopterous larvæ, &c., including a complete account of the life-history of the larvæ of *Sphinx convolvuli* and *Aglia tau*.'

Plate XV. *The ontogeny of* Sphinx convolvuli *up to the end of the 3rd stage :—*

Fig. 1, × 9. The ovum of *S. convolvuli*, as seen from above. This ovum appears to have been somewhat smaller than the

measurement given in the paper. The deep bluish green colour is peculiar, and the size *very* small for so large a species.

FIG. 2, × 5·8. The larva of *S. convolvuli*, as seen from the right side, and at the end of the 1st stage. The larva, which was stretched to rather more than the average length, was in the resting period before ecdysis: it was nearly ready for the change; the head of the 2nd stage has been drawn out of that of the 1st stage, and is now seen beneath the swollen anterior part of the prothorax: the 6 ocelli are distinctly visible beneath the skin of the prothorax. The black caudal horn, with its bifid termination, and very peculiar, although slight, forward curve, is distinctly shown; but the fine hairs upon it could not be indicated with this degree of magnification. The chief bristles springing from tubercular bases, are quite distinct. The subdorsal is visible, although it is probably a feature of the next stage, seen through the transparent skin.

FIG. 3, × 50. The horn of a similar larva in the 1st stage, as seen from the front. The shape is shown in outline; the details of the structure are throughout similar to those indicated in the upper part. The taper from base to tip is seen to be slight. The fork at the tip is very marked, the figure representing the larva with the deepest notch. The commoner form of termination is that shown in the next figure. The two terminal bristles are stout and large; their ends slightly clavate. The horn is thickly covered with fine short hairs springing from small tubercles.

FIG. 4, × 50. The tip of the horn of a similar larva seen from the same aspect. This represents the commoner form of tip, with the notch slightly indicated. In other respects the structure is identical with that represented in the last figure.

FIG. 5, × 24·5, The prothorax and head of a larva, similar to that shown in fig. 2, in the resting-period, as seen from above. The head of the next stage being drawn back, the ocelli are visible upon each side of the anterior part of the prothorax. Posteriorly, upon the same segment, the first spiracle is seen, upon each side. The figure represents one of the five larvæ which, in the 1st stage, possessed the brown prothoracic dorsal plate, and the brown anal patches. The plate is distinctly shown, together with the bristles which border it, which are similarly placed in larvæ without the brown plate. This structure evidently represents the plate which is so conspicuous in wood-boring and burrowing larvæ, Tortrices, &c.

FIG. 6, × 24·5. The parts around the anus in one of the same five larvæ, as seen from above and behind. This larva was also in he resting-period before the 1st ecdysis. The triangular brown

patch on the anal flap, and the quadrangular brown patches above each brown anal clasper, are distinctly shown, together with the arrangement of the bristles and their tubercles. The segment of which the posterior part is just indicated, is the 8th abdominal; the narrow 9th abdominal is very distinct, and it is seen to be clearly marked off from the 10th abdominal segment, which is made up of the parts around the anus, and the anal claspers. The bristles possess a very well-marked arrangement upon the dorsal part of the 9th abdominal segment.

FIG. 7, × 5·8. A larva rather more than half through the 2nd stage, as seen from the left side. The white shagreen dots have now appeared and are distinct; the white subdorsal line is prominent, and part of the 7th oblique white stripe can be seen. The horn is still curved *very* slightly forward, although this character is not indicated in the figure (see fig. 8). The tip is still bifid, and the surface is covered with thorn-like tubercles bearing bristles (see fig. 9).

The head is still rounded and of a generalised larval shape, as in the previous stage.

The larva represented was one of the seven darker varieties, with dark pigment strongly developed on the head, thoracic legs, claspers, below the anal flap, and round the spiracles. The horn was black in all the larvæ.

FIG. 8, × 5·8. A larva at the end of the 2nd stage, in the resting-period before ecdysis, drawn from the left side. The head is in the condition described in fig. 1. The larva was stretched to slightly over the average length. The figure is merely represented in outline, and the dark parts indicate the arrangement of the pigment.

The subdorsal and 7th oblique stripe are indicated by a line along the lower edge in each case. The larva represented was that one of the ten lighter larvæ of stage II., which first developed brown spots in the position of the red spots upon *Smerinthus* larvæ. The spots subsequently extended into faint stripes, and the whole feature was far more developed in this than in any other larva of the 2nd stage. It is shown at its maximum in the figure. The relation of the spots to the borders is quite distinct and unmistakeable. The patch of pigment between the 2nd and 3rd thoracic segments, probably belongs to the next stage, in which it becomes especially prominent. The shagreen dots are only seen in profile. The shade along the dorsal edge represents the dorsal line, due to a deeper shade of ground colour.

FIG. 9, × 24·5. The caudal horn of the 2nd stage as seen from the front. The horn is still bifid, and terminates in two divergent

bristles. The thorny tubercles covering the surface are distinctly shown. The colour is black, with a light semi-transparent zone near the tip. In this respect the horn resembles that of the young *Aglia tau*, the red pigment being absent from a similarly placed zone in this species (compare Plate XVII., figs. 3 and 4).

FIGS. 10, 11, 12, and 13, all × 3. These four figures represent different varieties of the larvæ, rather more than half-grown in the 3rd stage; all seen from the right side. The larvæ figured are indicated in the paper. They were chosen to represent a transition from one of the lightest larvæ of this stage (fig. 10) to the darkest (fig. 13). The former is seen to be extremely Smerinthine in appearance, possessing the characteristic red spots, and very little pigment except upon the horn. The traces of dark borders to the stripes above the subdorsal line are noteworthy. In fig. 11, the amount of pigment has greatly increased in depth and extent; the dark borders tend to pass anteriorly along the upper margin of the subdorsal. In these two larvæ the light zone on the horn is marked. In fig. 12, the borders have extended along the subdorsal, thus shutting off a dorsal area of ground colour, which becomes of a deeper green. In fig. 13, this area has become suffused with dark pigment, of which the depth diminishes towards the dorsal line. The larva is very dark as compared with the others, the head and anal region being especially black. The larva represented was the darkest of all in this stage.

The change in tint of the ground colour of the larvæ, from bluish green in the palest larvæ, through intermediate tints to yellowish green in the darkest larvæ, is very remarkable.

The shagreen dots are not represented in the figures. The dark mark between the 2nd and 3rd thoracic segments apparently completing the series of spiracular marks, into a system with equal intervals, is especially noticeable in figs. 10 and 11. The head has now assumed a more characteristic shape. The caudal horn is straight.

FIG. 14, × 5·25. The same larva as that represented in fig. 13, seen from the left side and above, in a somewhat curved position. This was much the darkest of all the larvæ in the 3rd stage. The broad dark dorsal band is a very striking feature, of which not a trace is visible in the paler larvæ (fig. 10). The shagreen dots are represented in this figure. Two of the chief tubercles (from which the chief bristles spring) of the first stage (fig. 2) are seen upon each abdominal segment, one being above and one below each spiracle, except upon the 8th segment, in which one is above and one behind the spiracle. The others are also present, but less conspicuous, so that they could not be shown in the figure. The

shagreen dots are darker in colour upon the blacker parts of the larva.

FIG. 15, × 9. The head of the last larva, as seen from the front. The black bands have spread so as to cover by far the greater part of the surface, while the green ground colour, which is uncovered by them, is far darker than in the other larvæ.

FIG. 16, × 14·5. The caudal horn of the 3rd stage, as seen from the front. The anterior side of the base is represented by the curved mark; below this mark a small part of the dorsal surface of the 8th abdominal segment is represented. The horn is still bifid, although the notch is not so marked as in the last stage (fig. 9). In other respects the structure is similar. The transparent zone, present in many larvæ of this stage, is represented in the figure.

PLATE XVI. *The ontogeny of* SPHINX CONVOLVULI, *4th and 5th stages*:—

FIGS. 1, 2, 3, 4, and 5, all × 2. These five figures represent different varieties of the larvæ at the end of the 4th stage; all seen from the right side. The larvæ represented are indicated in the paper. These also represent a transition from the green to the dark larvæ.

The transition is, however, of greater extent than this series alone, for it is continuous through the darkest larva of the last stage (Plate XV., figs. 13 and 14), to the lightest Smerinthine larva shown in Plate XV., fig. 10. The gradual disappearance of the green ground colour is very beautifully traced in this series of larvæ in the 3rd and 4th stages. Fig. 1 was the lightest of all the larvæ in the 4th stage; there was, however, a single larva intermediate between it and fig. 2. These three larvæ were the only green varieties which occurred in this stage. In fig. 3, the lightest of the dark larvæ is represented; distinct traces of the green ground colour can still be seen. Fig. 4 is one of the dark varieties, with very prominent subdorsal and subspiracular lines. Fig. 5 is one of the darkest of the larvæ in this stage.

The horn is now curved backwards, and appears to be smooth and shining, although it still retains small tubercles. The transparent zone is still present in many larvæ, and traces of the forked tip are very generally present. The larvæ were still distinctly shagreened, but this is not indicated in the figures. The distinct subdorsal and subspiracular are very conspicuous in many of the dark larvæ. The orange spiracles also form a very prominent feature.

FIGS. 6, 7, 8, 9, and 10, all natural size. These five figures represent the five chief varieties of the larvæ when approaching maturity; all seen from the right side. The differences are now

much less than in the earlier stages. The chief variations are in the shade of ground colour, which passes from brown to black, in the prominence of the subdorsal, subspiracular, and oblique stripes and their borders. The subdorsal is often represented by a single spot on each segment posterior to the 1st abdominal. In the lightest varieties there is a dorsal stripe above the subdorsal, also tending to form spots (above the subdorsal spots); this is indicated in figs. 6 and 7. The larvæ represented in the figures are described in the paper.

The horn is now smooth, polished, and curved like that of *S. ligustri*. There is no trace of the bifid extremity and the tubercles of earlier stages. The dorsal prothoracic plate is very distinct and polished. Traces of shagreen dots can be distinctly seen immediately after ecdysis, as in *S. ligustri;* but most of them disappear or become very inconspicuous in the course of a few hours. They can still be detected, and are represented in the figures, in the faintly marked oblique stripes.

Fig. 11, × 7. The head and prothorax of a larva in the resting-period before the last ecdysis, as seen from the right side and above. The prothoracic dorsal plate, which is not conspicuous earlier in the stage, now comes out with great distinctness. Its colour is darker than the surrounding cuticle, and its rigidity prevents it from being thrown into wrinkles by the strain which affects the cuticle in this way. The wrinkles are especially distinct round the margin of the plate. The shagreen dots are especially large on the plate; they are small and dark on the black head, and are absent from the anterior neck-like part of the prothorax, into which the head of the next stage is being retracted. The subdorsal line is shown in outline on both sides; the prothoracic spiracle on the right side only.

Fig. 12, × 7. Part of the 6th abdominal segment of a larva, in the 5th stage, immediately after the last ecdysis, as seen from the left side. The appearance represented only remains for an hour or two after ecdysis, for the rapidly darkening cuticular pigments cover up and hide the subcuticular pigment upon which the first appearance depends. The shagreen tubercles are seen to be still present, although very small, each being surrounded by a circular white area, which corresponds to the tubercles of the previous stage. The ground colour is purplish above and yellowish below; the border to the stripe is purplish, but blue in the central part. The appearance somewhat suggests that of *Acherontia atropos*. Two of the chief tubercles and bristles are very prominent. The eight annuli of the segment are distinctly shown.

PLATE XVII. *The ontogeny of* AGLIA TAU, &c.

FIG. 1, × 9. The newly hatched larva of *A. tau*, seen from above, and slightly from the left side, showing the five characteristic spines in a wrinkled and contracted state. In about twenty minutes they are expanded to their full size (as shown in fig. 3), by the pressure of the larval blood; they then become stiff and rigid. The dorsal tubercles are pressed down flat on the back of the larva, with their apices directed towards the middle line. The details of the whole of the tubercular coverings are not indicated, the magnification being insufficient to represent the indistinct condition of these structures immediately after hatching.

FIG. 2, × 7. A larva of *Aglia tau*, crawling out of the egg-shell, as seen from above. The four thoracic spines are in the contracted state as in the last figure. The egg-shell is seen from one of its long sides.

FIG. 3, × 7. The larva of *A. tau*, after having fed for a few days in the first stage, as seen from above. The five horns are very characteristic in appearance; the one on the 8th abdominal segment corresponds in every way to the caudal horn of *Sphingidæ*. The transparent area corresponds to that shown in Plate XV., figs. 9 and 16, &c., in the case of *S. convolvuli*. The forked tip, with its two terminal bristles, is like that of all young *Sphingidæ* hitherto described (see Plate XV., fig. 3, &c.). Four hair-bearing tubercles are seen on each side of each abdominal segment.

FIG. 4, × 50. The caudal horn of a similar larva showing the details of its structure, as seen from the front. The four thoracic horns are essentially similar.

FIG. 5, natural size. The adult larva of *A. tau*, at the end of the 4th (and last) stage, as seen from the right side. The differences between this and the earlier appearance (fig. 3) are very striking, and appear suddenly at the beginning of the last stage, the three previous stages being very uniform. The shagreen dots are like those of *Smerinthus* and *Sphinx*, and appear in the 2nd stage. The anterior part of the larva bears some rough resemblance to the head of a vertebrate animal; and there is a black mark on the 1st abdominal segment, which is in the appropriate position for the vertebrate eye. This terrifying mark is only exposed when the larva is irritated (as shown in the figure). The subspiracular line is very distinct and prominent, being composed of fleshy lobes. The terrifying mark is situated just above this line, and is in the form of a pouch, which can be opened, and thus rendered visible.

FIG. 6, × 5·25. Part of the 1st abdominal segment of a similar larva, seen from the right side. The terrifying mark is almost

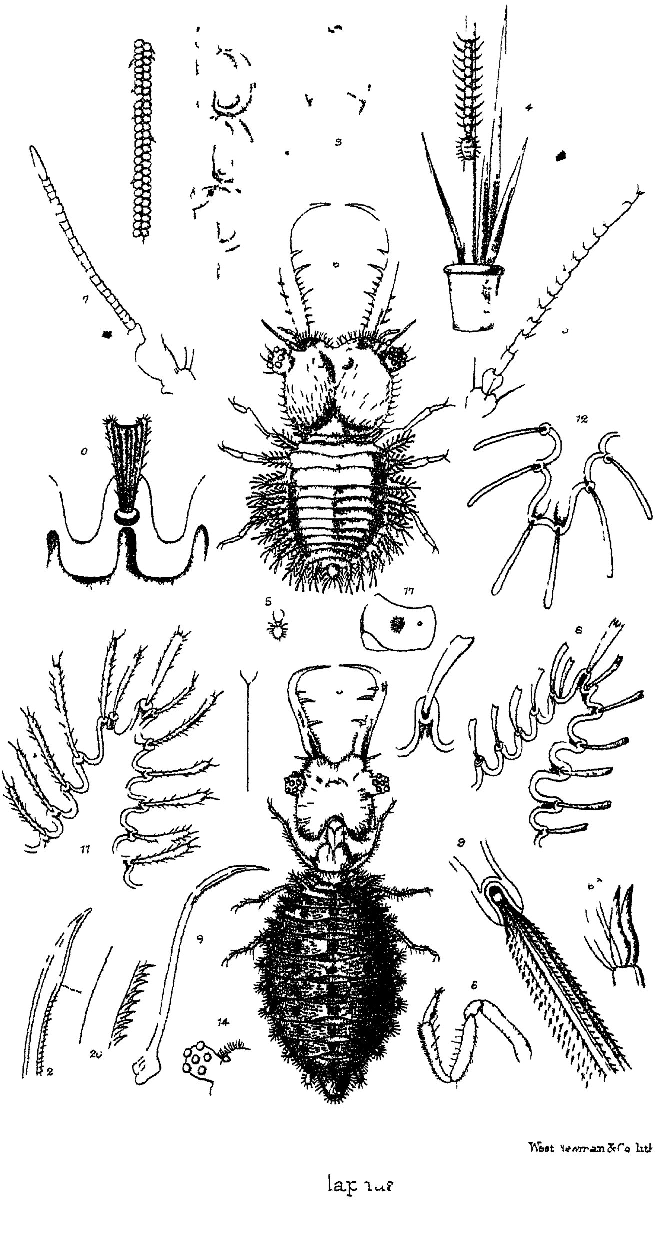
concealed in this case, although the red margin can be seen. The pouch is drawn downwards and inwards behind the fleshy lobes of the subspiracular line. The shagreen dots are distinctly shown, together with the different shades of green ground colour, above and below the subspiracular. The larva represented was a yellowish green variety.

FIG. 7, × 4·5. The 1st and 2nd abdominal segments of the larva of *Stauropus fagi*, as seen from the right side. The details of structure are only shown in the posterior part of the 2nd abdominal segment. The two black marks which are exposed when the larva is irritated are distinctly indicated. They resemble the single mark of *A. tau*, being in the form of pouches, which can be opened and closed. The lower lip takes the form of a projecting flap, which conceals the pouch when it rises, and exposes it when it is depressed. The black marks are only exposed, as in the figure, after extreme irritation. These marks, doubtless, represent the black scars caused by ichneumon stings or wounds, and afford the larva protection from parasites by suggesting that it has been already attacked.

FIG. 8, × 24·5. The young larva of *Euclidia mi*, after having grown for a few days in the 1st stage, as seen in the geometriform attitude from the left side. The chief bristles and tubercles are very distinct. The 9th abdominal segment is clearly marked off from the 8th and 10th. The 1st and 2nd claspers are absent, and the larva closely resembles a geometer in structure and movements.

FIG. 9, × 9. The posterior part of the larva of *Ephestia kuhniella*, as seen from the right side. The larva had been somewhat compressed, so that its dorso-ventral diameter is greater than in the normal state. The dark squarish body on the upper part of the 5th abdominal segment (the anterior segment figured) is the right testis; it is of a brown colour. The chief bristles and tubercles are plainly seen. The 9th and 10th abdominal segments are very sharply marked off and distinct.

FIG. 10, × 9. The 5th and 6th abdominal segments of the same larva, as seen from above. The larva had been compressed so that the diameter from side to side is greater than normal, and the testes are separated by an unusual distance. These organs are distinctly seen beneath the skin of the 5th abdominal segment, just projecting beyond the posterior margin of this segment into the 6th abdominal. The dorsal vessel is faintly seen. The chief bristles are distinct.



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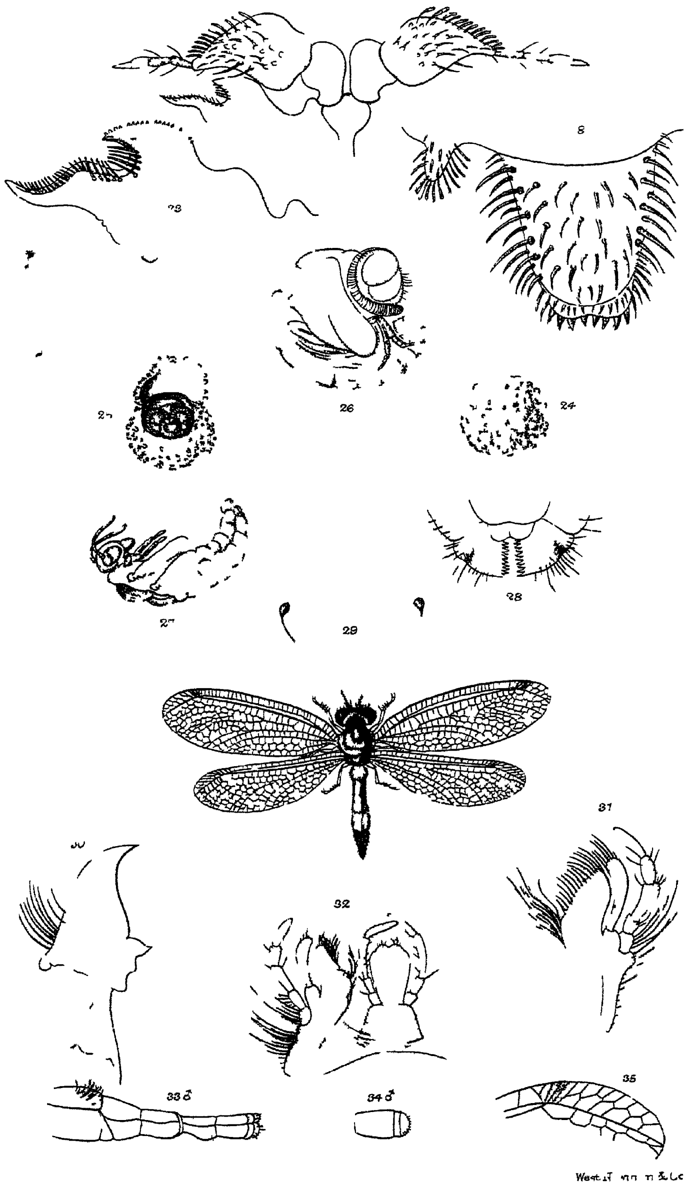

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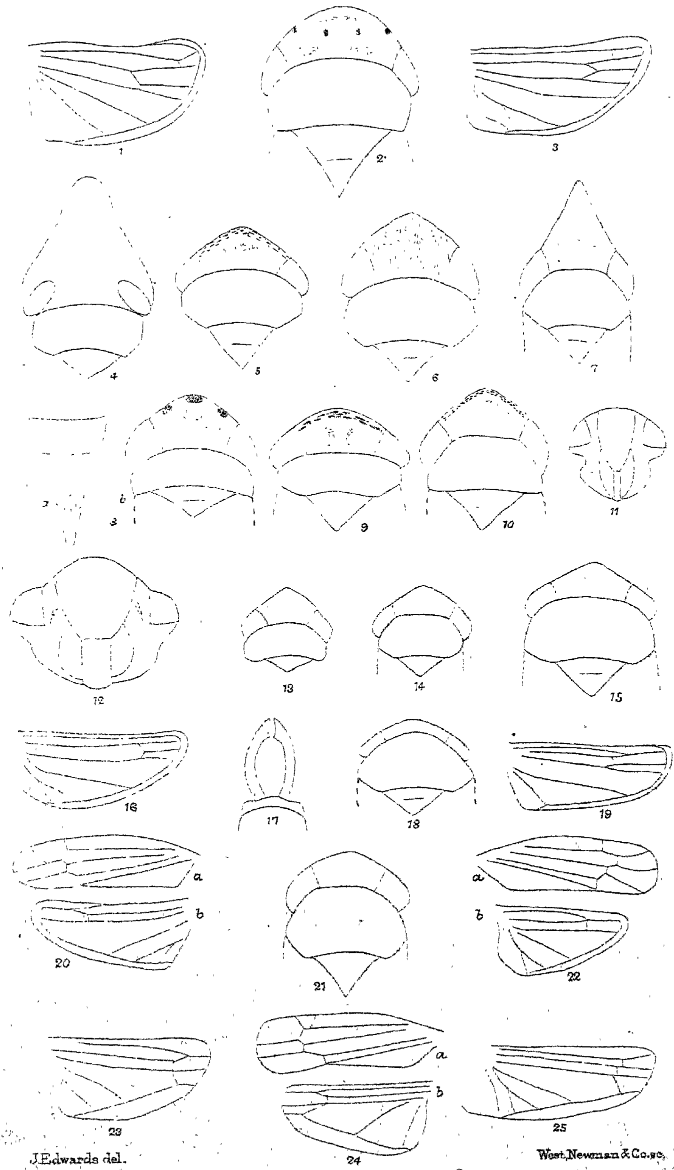

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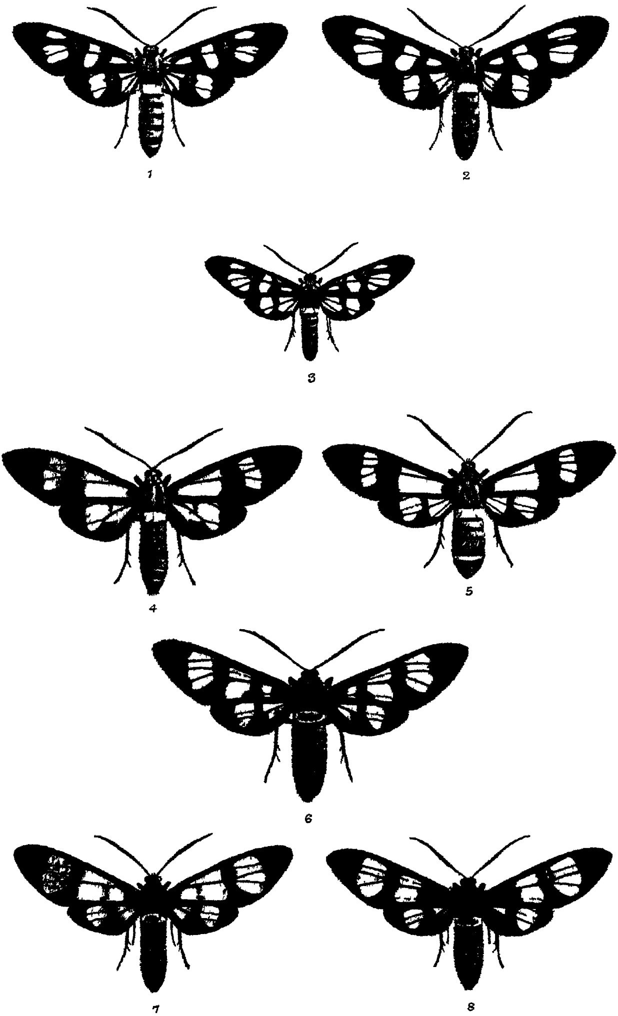

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Species of Euchromia

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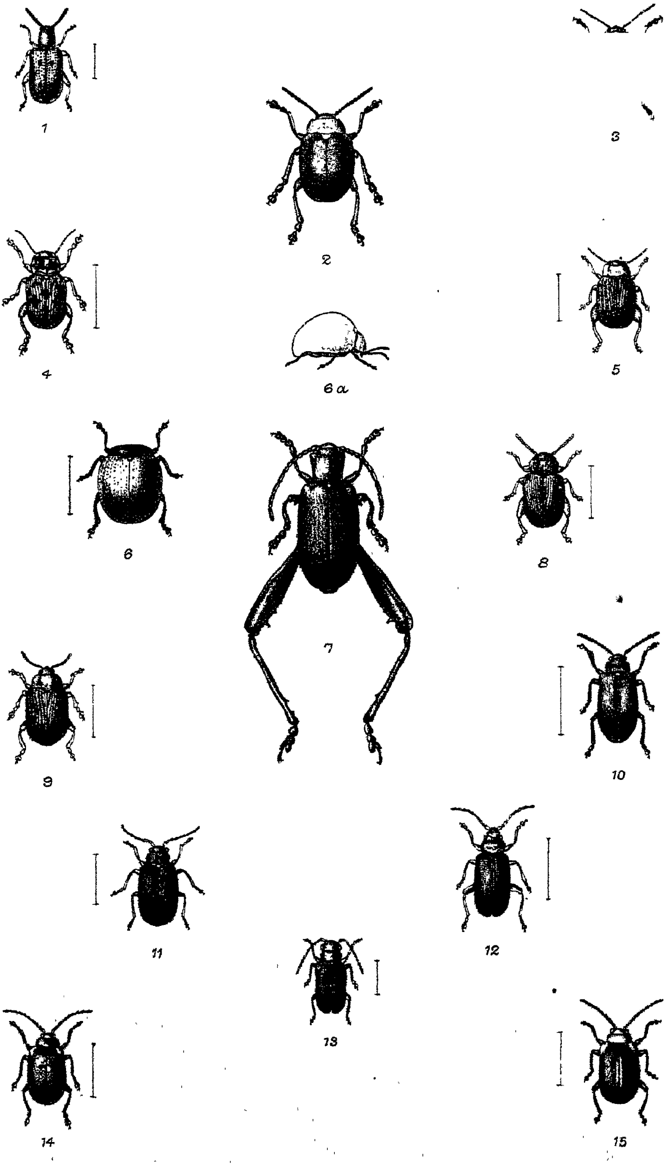
Larvæ & pupæ of Rhopalocera from the Australian Region



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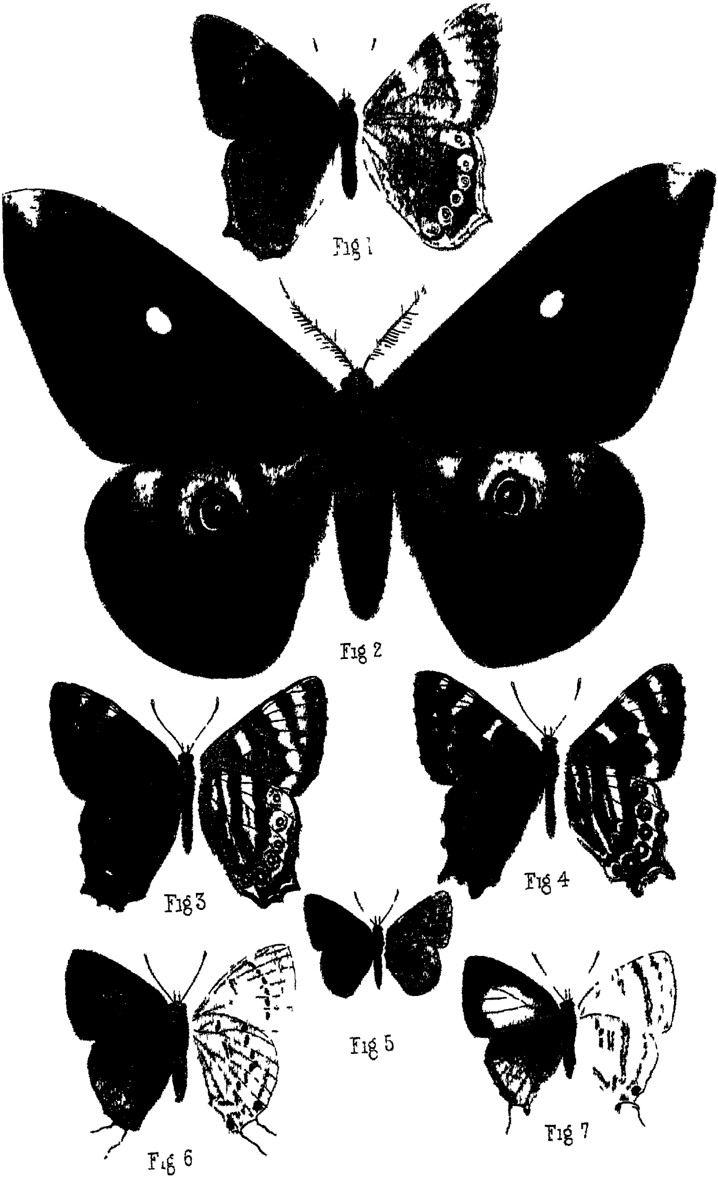
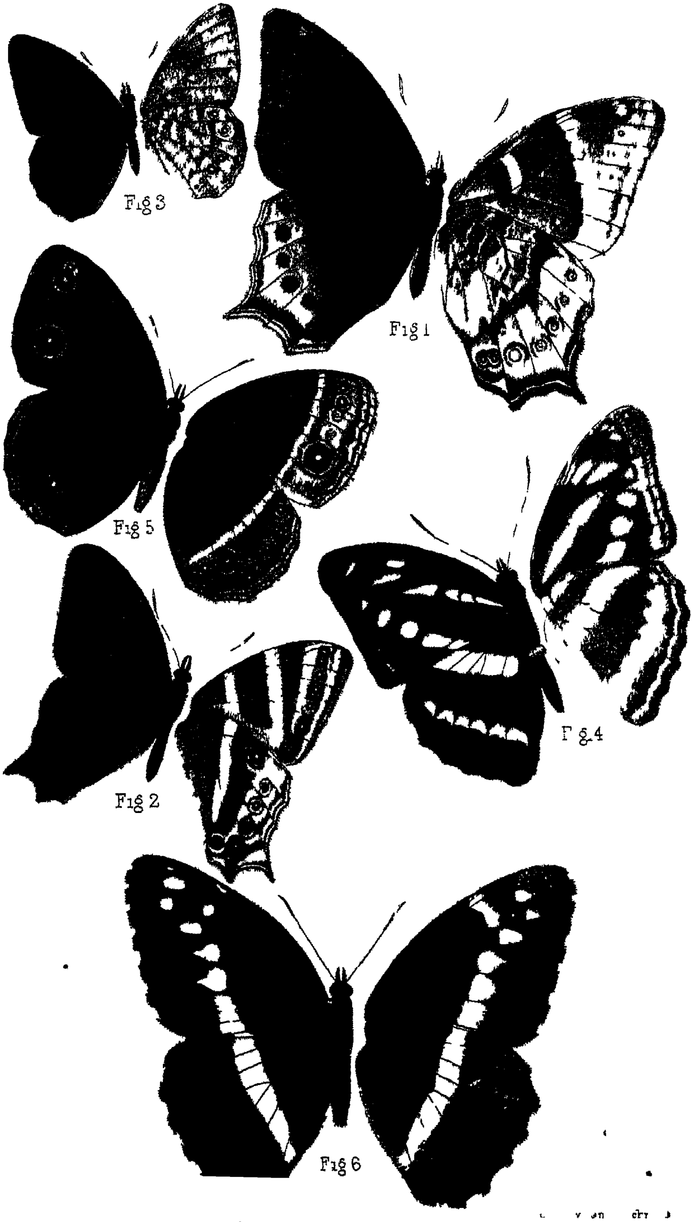
African Coleoptera.



Sikkim Lepidoptera



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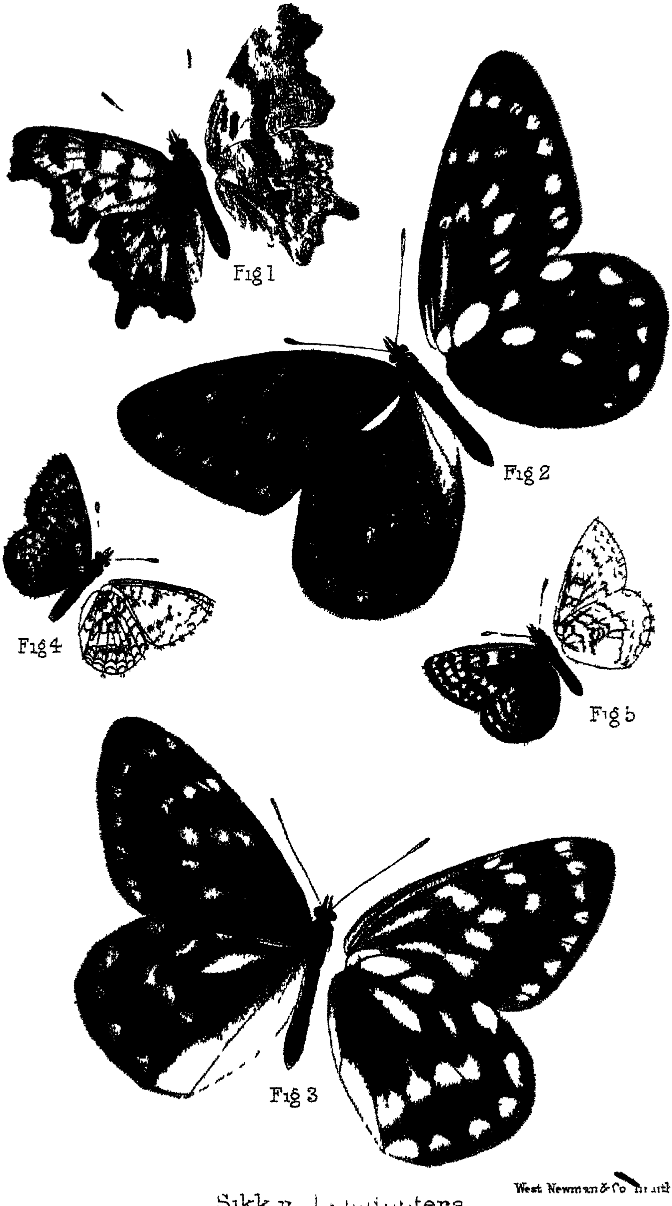

Fig 1

Fig 2

Fig 4

Fig 5

Fig 3

Sikkim Lepidoptera

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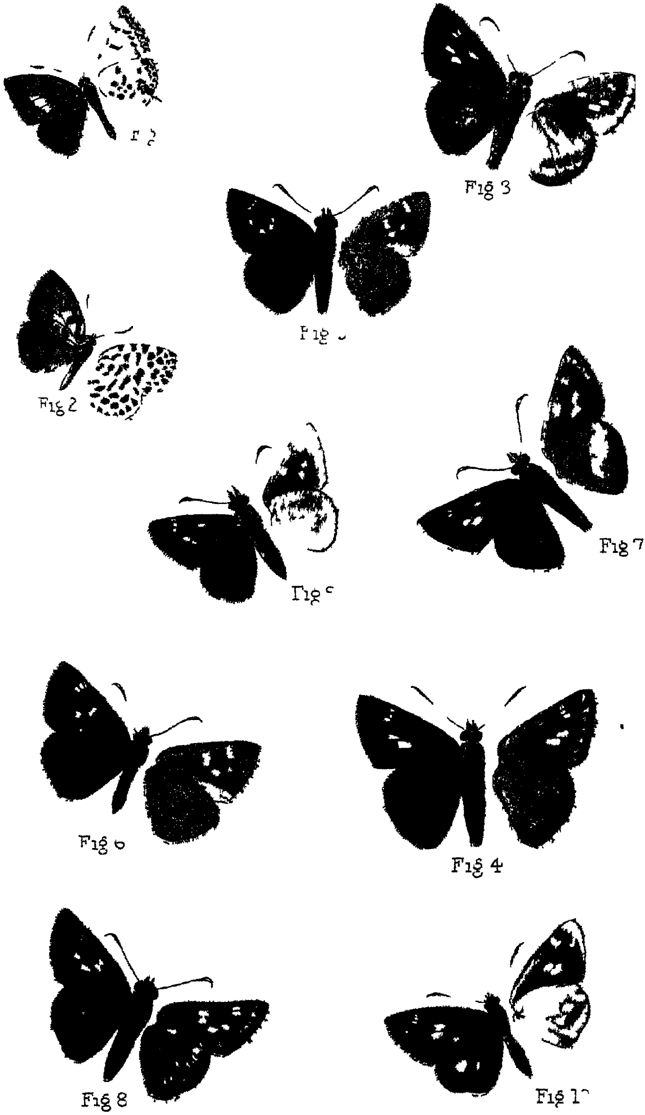

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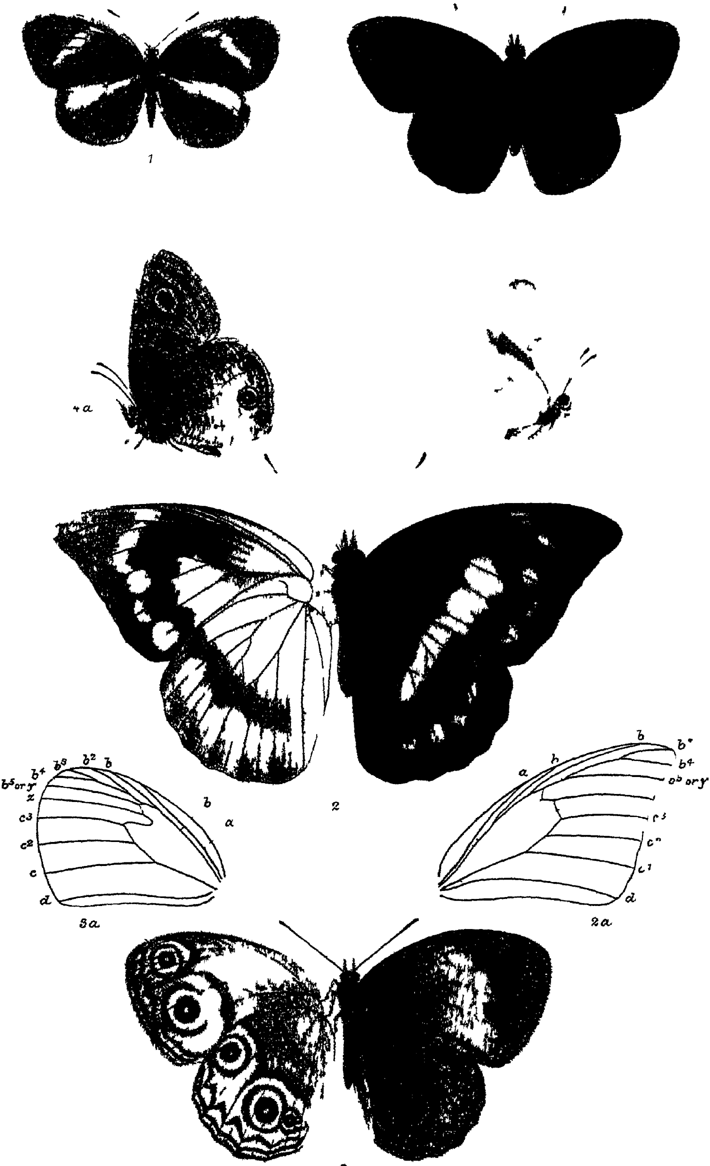

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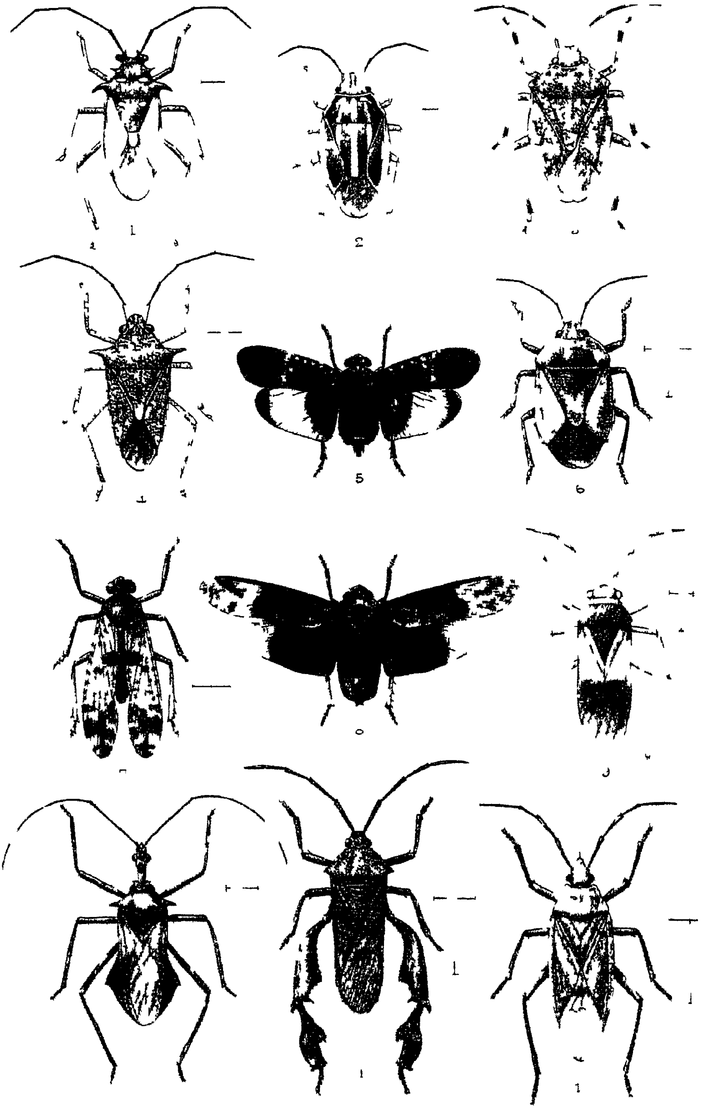
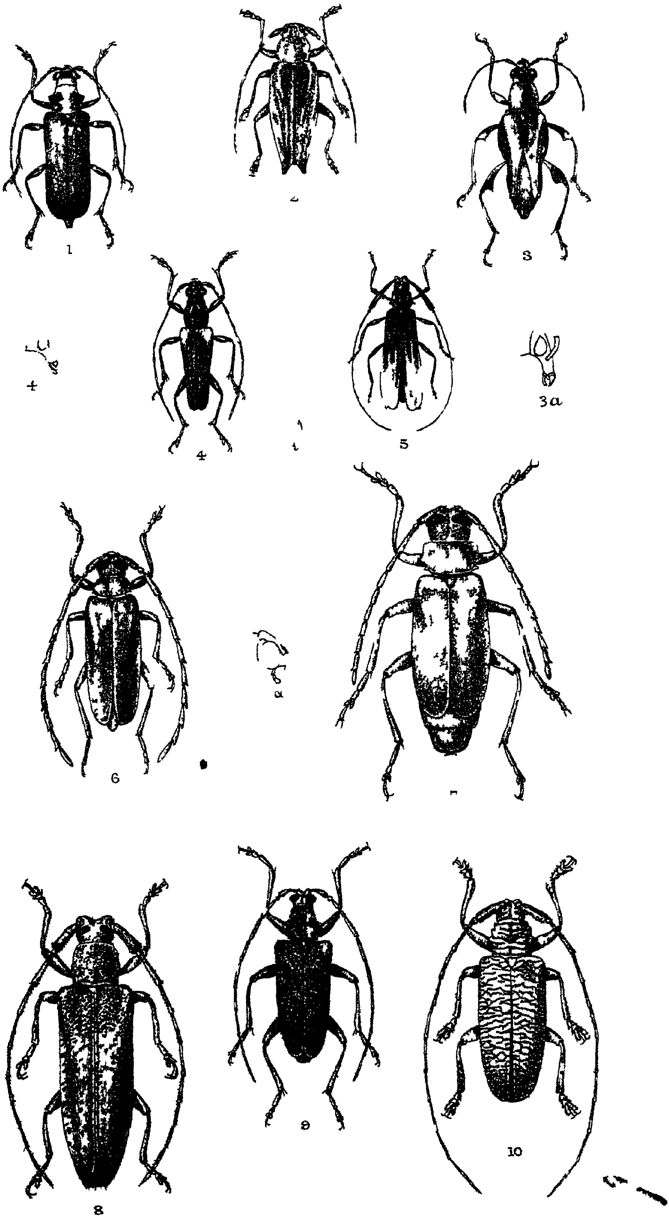
Plate I





Horace Knight del

New Longicornia

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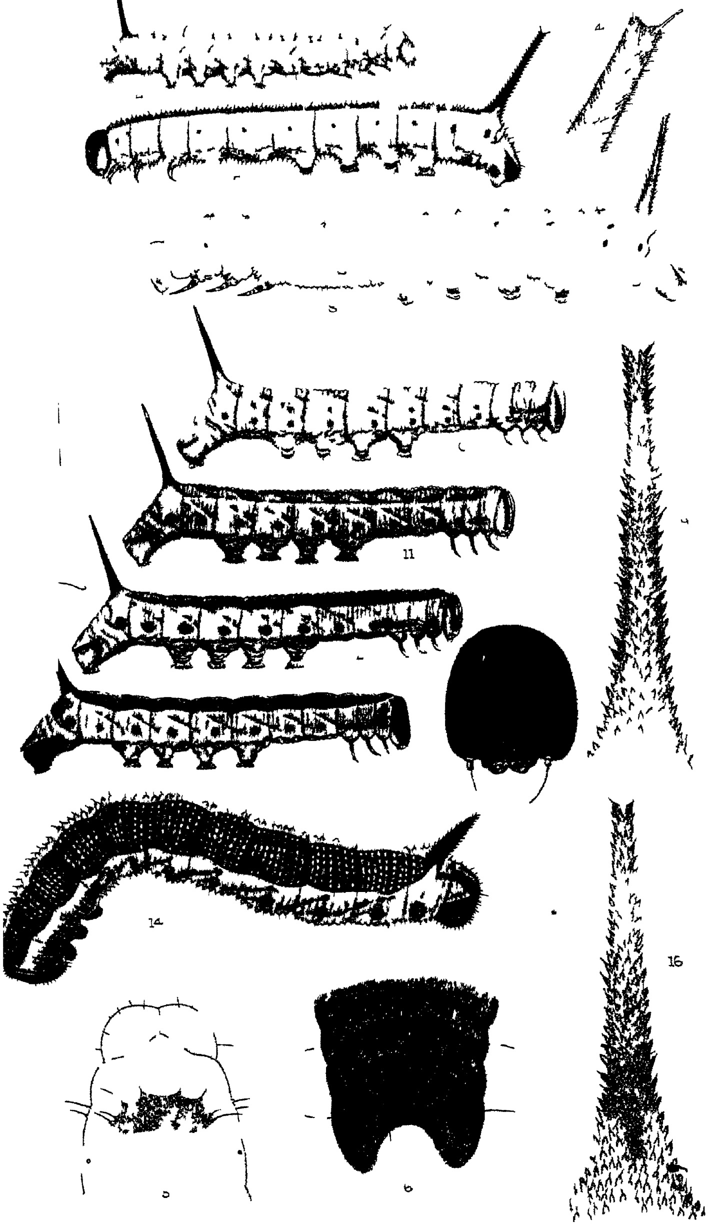
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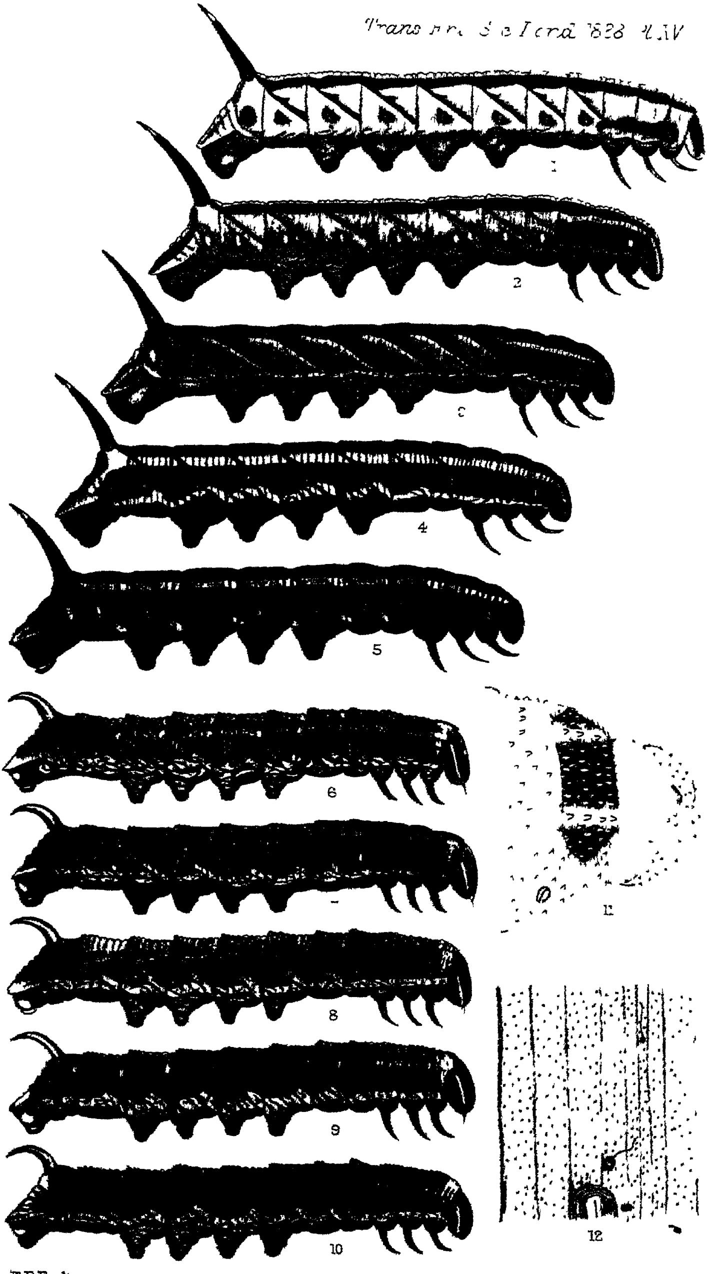
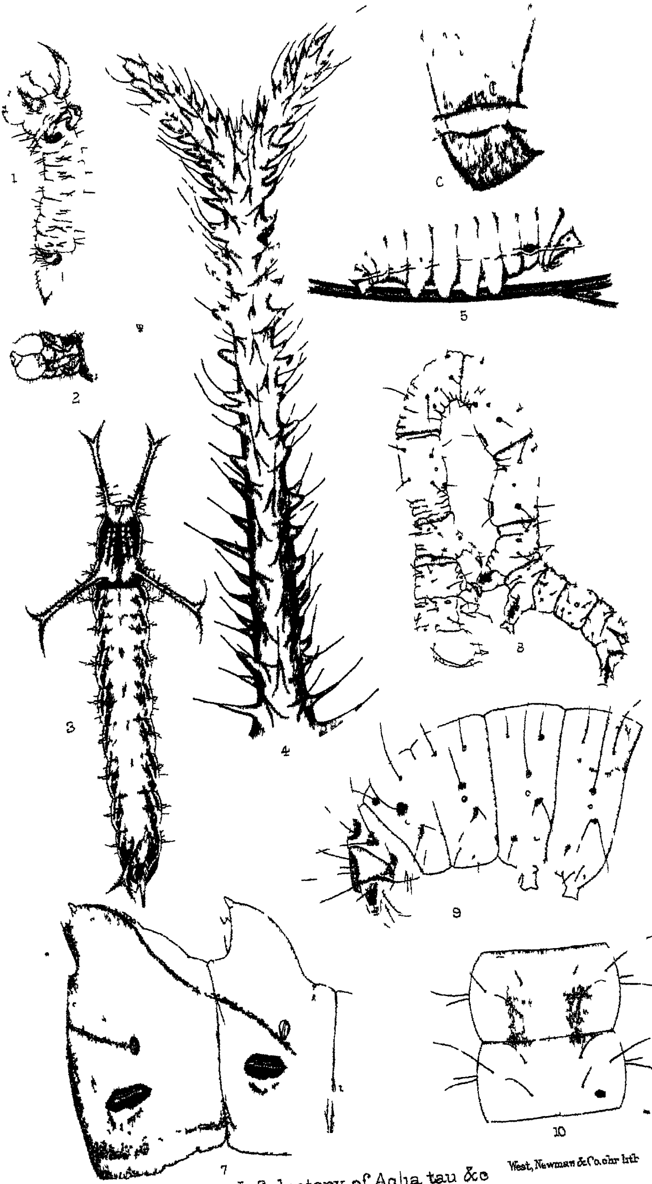


E.B Poulton pinx

West Newman & Co chr lith

Life-history of Sphinx convolvuli.



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Life history of Aglia tau &c

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PROCEEDINGS

OF THE

ENTOMOLOGICAL SOCIETY

OF

LONDON

FOR THE YEAR 1888.

February 1, 1888.

Dr. DAVID SHARP, M.B., F.Z.S., President, in the chair.

Donations to the Library were announced, and thanks voted to the respective donors.

Nomination of Vice-Presidents.

The President nominated Sir John Lubbock, Bart., M.P., F.R.S., Mr. Osbert Salvin, M.A., F.R.S., and the Rt. Hon. Lord Walsingham, M.A., F.R.S., Vice-Presidents for the Session 1888 to 1889.

Election of a Fellow.

Mr. Henry F. Dale, F.R.M.S., F.Z.S., of Miserden, Gloucestershire, and 2, Savile Row, W., was elected a Fellow.

Exhibitions, &c.

Mr. F. Pascoe exhibited two specimens of a species of the Hemipterous genus *Ghilianella*, one of which he found crawling over a low bush at Pará with the young larva—whose long and slender abdomen was coiled round the thorax—securely riding on its back. He said it was the only occasion he ever saw the species with the larva, which was new to Mr. Bates.

Dr. Sharp exhibited a number of insects forwarded to him by Mr. Kidston, of Stirling, collected by Mr. Alexander Carson on Kavalla, an island in Lake Tanganyika: they were sent in spirit, and unfortunately were much damaged in transit. The Coleoptera were nearly all well-known species, exemplifying the fact that many of the commoner insects of tropical Africa have wide distribution there, some of these species being common both to Natal and Senegal. The most remarkable of the insects received from Mr. Carson was a large lepidopterous caterpillar, which Dr. Sharp had given to Mr. Poulton; it was covered with very thick sharp spines, all pointed, except the terminal one in the mesial line which was furcate.

Mr. Champion exhibited specimens of *Casnonia olivieri*, Buq., *Œdichirus unicolor*, Aubé, *Paussus favieri*, Fairm., *Colydium elongatum*, Fab., *Endophlœus spinulosus*, Latr., *Hetærius arachnoides*, Fairm., *Pseudotrechus mutilatus*, Rosenh., *Singilis bicolor*, Ramb., and *Phyllomorpha laciniata*, Will., all recently collected by Mr. J. J. Walker, R.N., of H.M. ship 'Grappler,' at Gibraltar, Tetuan, and Tangier.

Mr. R. South exhibited a remarkable variety of *Polyommatus phlœas*, caught by him in North Devon in 1881.

Mr. R. W. Lloyd exhibited a living specimen of a species of *Ocnera* taken in London amongst merchandise imported from Ispahan.

Mons. Alfred Wailly exhibited four cases containing a large number of cocoons of *Antheræa assamensis*, *A. roylei*, *Attacus ricini*, and *Actias selene*. The first case contained a number of dead moths which had emerged on the voyage, paired, and laid eggs which had hatched, the young larvæ being alive on the arrival of the case. In the second case only about ten moths had emerged, some of which were alive at the time of its arrival. In the third case all the moths had emerged, and were broken to pieces; some of the ova which had been laid had hatched, and the larvæ were alive on their arrival. Mons. Wailly said it was evident that to have any chance of obtaining cocoons alive, they must be sent, as soon as formed, in small boxes by Sample Post.

Mons. Wailly also exhibited seven bags, or nests, of the

cocoons of *Bombyx rhadama* (the silk of which is used by the Hovas in the manufacture of their stuffs called "Lambas") which had been sent to him from the island of St. Mary, Madagascar. He stated that only a comparatively small number of moths had emerged on the voyage; and he remarked that the cocoons were small, of a pure white colour, and surrounded by a quantity of silk of a buff-colour.

Mr. H. Goss observed that, according to Mr. Poulton's experience, it was a remarkable feature of these nests that the silk forming the outer covering should be a dark buff-colour, while the cocoons enclosed in them were pure white.

Paper read.

Mr. H. J. Elwes read a paper on "the Butterflies of Sikkim," the result of many years of collecting in that wonderfully rich district of the Himalayas. He said he had been enabled to complete his observations during the enforced delay at Darjeeling of Mr. Macaulay's Mission to Thibet, of which he was a member. He stated the number of species occurring in this small district to be about 530, which is greater than the number hitherto found in any locality in the Old World. Of these the greater part only occur in the hot valleys at an elevation of 1000 to 3000 feet, and these are for the most part of a purely Malayan character, whilst those found in the middle zone are in many cases peculiar to the Himalayas; and the few species from the alpine parts of the country at 12,000 to 16,000 feet are of a European or North Asiatic type. An important feature in this paper was the numerous observations taken on the habits, variation, seasons of appearance, and range of altitude, of the various species, for which Mr. Elwes said he was largely indebted to Herr Otto Moller, of Darjeeling. The paper concluded with an analysis of the species and genera as compared with those found in the North-West Himalayas and in the Malay Peninsula.

Mr. J. H. Leech, Dr. Sharp, Mr. Elwes, and others took part in the discussion which ensued.

March 7, 1888.

Dr. David Sharp, F.L.S., F.Z.S., President, in the chair.

Donations to the Library were announced, and thanks voted to the respective donors.

Election of Fellows.

Mr. Frederic Pennington, jun., of Broome Hall, Holmwood, Surrey; Mr. W. Crush, of Ulundi Road, Westcombe Park, Blackheath, S.E.; and Mr. James Plumer Cregoe, of 26, Rutledge Avenue, Charleston, South Carolina, U.S.A., were elected Fellows.

Exhibitions, &c.

Mr. J. H. Leech exhibited, and made remarks on, a number of butterflies forming part of the collection made for him during last summer by Mr. Pratt at Kiukiang, Central China. The specimens included *Papilio macilentus*, hitherto only recorded from Japan; a series of varieties of *Papilio sarpedon*, selected from over a hundred specimens, in most of which the blue spots of the hind wings were entirely absent; also a pale green variety of this species which Mr. Leech believed to be a new or very rare form; a supposed new species of *Papilio* with very broad tails, traversed by two nerves instead of one; a series of *Sericinus telamon*, selected from over 300 specimens, no two of which were alike; varieties of *Acræa vesta*; examples of *Charaxes narcæus* and the variety *mandarinus*, which latter Mr. Leech said was the common form at Kiukiang; *Ypthima sakra*, a species new to China; *Palæonympha opalina*, Butl.; some new or unknown species of *Lethe*, *Neptis*, and *Apatura*; and a series of *Argynnis paphia* with the variety *valezina* of the female. Mr. Leech stated that all the females of *A. paphia* taken at Kiukiang belonged to the variety *valezina*, the typical form of the female being unknown there. He also remarked that in studying Chinese Lepidoptera it was of great importance to have a long series of every species, as in many cases the varieties intermediate between the typical form of a species and its local forms are extremely rare, and

without large numbers of examples for comparison mistakes in the identification of species were sure to occur.

Mr. E. B. Poulton expressed great interest in Mr. Leech's statement that the female of *Argynnis paphia* was apparently only represented at Kiukiang by the dark *valezina* form. In this country the dark variety was well known in the New Forest, and a single specimen had been captured on Streatly Hill, Berkshire. It probably also existed in other localities in the South of England. On the other hand, the typical form of the species was excessively abundant in Devonshire, and yet the *valezina* form had never been seen there. The facts that the dark variety is the only form at Kiukiang; that in many European localities there is a small percentage of dark females; and that again in other European localities these dark varieties are never found,—seem to bear, in an important manner, upon the difficult problem of the origin of dimorphism in Lepidoptera. Such dimorphism is probably to be explained in the same manner as the dimorphism of Lepidopterous larvæ, the question being complicated by the existence of sexual selection in the former case. It is probably due to the variability of a form which is represented by one of the two varieties now known: the disappearance of intermediate varieties led to the existence of two well-marked and clearly separated forms; finally, the gradual predominance of one of these forms over the other, of the new over the old, is probably taking place in many localities, and has already taken place in others. The fact of the relative abundance of *A. valezina* in different localities would seem to imply that it is the older form, which has been replaced in most English localities. It is to be noted that intermediate varieties still occur, although very rarely. Mr. Poulton further said he thought it would be of extreme interest to trace the same facts still further in other localities, over the whole range of the species, and to look for kindred phenomena in other fritillaries. The case of *Colias edusa* would also yield most interesting and important results if carefully studied from the same point of view.

Mr. Jenner Weir stated that he had bestowed much time,

for several years in succession, in collecting *A. paphia* and the form of the female known as *valezina* in the New Forest, and that he had obtained a series of forms intermediate between the typical form of the female and the variety *valezina*.

Mr. H. Goss said that about eighteen years ago he had seen a specimen of *A. paphia*, var. *valezina*, caught in Ashdown Forest, Sussex; but that, with the exception of this specimen, he had never seen *valezina* out of the New Forest. The typical form of the species was very abundant in Monmouthshire, but he believed there was no record of the capture of *valezina* in that county.

Mr. McLachlan suggested that possibly some entomologists might regard the species from Kiukiang referred to by Mr. Leech as *Argynnis paphia*, as not identical with the species known by that name in Europe.

Mr. Champion exhibited about 950 species of *Coleoptera* recently collected by Mr. J. J. Walker, R.N., near Gibraltar.

Mr. McLachlan called attention to the large number of species of water-beetles included in Mr. Walker's collection.

Mr. Kirby suggested that the attention of the Imperial Institute should be called to the interest and importance attaching to the exhibition of local collections of insects from British Colonies and possessions.

Mr. Verrall exhibited living specimens of *Aspidomorpha sanctæ-crucis*, and another species unnamed, from the caves of Elephanta.

Mr. Slater exhibited specimens of a species of weevil which had been doing much damage to maize sent to the Colonial Exhibition.

Paper read.

Mr. William White read a paper entitled "Experiments upon the Colour-Relation between the pupæ of *Pieris rapæ* and their immediate surroundings," which comprised a detailed account and discussion of a series of observations carried on by Mr. George C. Griffiths at Bristol, at his instigation. The various experiments were intended to act as a further test of the conclusions arrived at by Mr. E. B.

Poulton in his ample paper on the subject, which was read before the Royal Society last year, and recently published in the Philosophical Transactions of that Society; and to effect such test different and additional influences were adopted, so that an analogy might be drawn between the two sets of results.

Previous observers had freely stated that it was the habit of chrysalides to assume the precise colouration of whatever surface they were attached to, and the untested facts of the case had been considerably exaggerated. Professor Meldola, however, had modified such statements by declaring that in the process of pigmentation there was no analogous relation whatever to external photographic agency, the action of light upon the sensitive skin of a pupa being of a special nature altogether. The conclusions drawn by Mr. Poulton from very extensive practical tests fully bore out the truth of Prof. Meldola's opinion, and it was interesting to apply additional experiments to the point.

Between 80 and 90 larvæ were employed by Mr. Griffiths in these experiments, and of this number 74 pupæ resulted which were properly available for precise analytical treatment. These were spread over a series of four orders of condition, namely:—The influence of "Single Colours" proper; "Parti-colour" tests (of secondary importance); "True Conflicting-colour" experiments; and "Miscellaneous" conditions.

Mr. White said the methods of analysis, and standards of estimation which had been devised by Mr. Poulton in the course of his researches, were closely adhered to throughout Mr. Griffith's experiments, so that a true comparison of the results of the two series of experiments might be duly made. Mr. White further acknowledged his indebtedness to Mr. Poulton for the personal aid he had afforded him in the classification of the pupæ.

The range of colours employed as influences included black, white, blue (two shades), pink, red, yellow, green, gold, &c.

An important point in relation to the period when the pigment is chiefly developed in pupæ, had been discovered

by Mr. Poulton in the course of a large number of experiments which he made upon larvæ during the period preparatory to pupation, which period he supposed to consist of three stages; and this discovery that the second and early part of the third stage of the "Pre-pupational Period" (as Mr. White proposed to call it) is the time of chief susceptibility, had been applied to these experiments. The results of these recent experiments were entirely confirmatory of Mr. Poulton's discovery, which is found to throw much light upon the subject. Most of the colours employed affected the pupæ very materially, while some few, chiefly blue, produced only "normal" pupæ. Black, green, and yellow were found to be the most potent influences; black surroundings producing much pigment, and completely covering the surface of the pupæ in many cases; green produced in most cases *pale green* pupæ, while yellow was still more efficient in the production of an *intense green* colour without any pigment spots.

The results of each group of experiments were separately considered in the paper according to Mr. Poulton's Standard Grade of pupal colouration, and afterwards collectively tabulated for the purpose of comparative analyses of the different colour-factors, and again for comparison with the results of Mr. Poulton's similar experiments. The various results were finally delineated* by means of a "curve," which followed the lines of that obtained by Mr. Poulton so closely as to add very strong testimony indeed to the efficiency of the causes as constant factors.

The living pupæ experimented on were exhibited, together with a number of normal specimens for comparison with them, and also sample pieces of the coloured papers employed in the experiments.

Mr. Poulton said that he was very much interested in the results of Mr. Griffith's experiments. When he had himself experimented upon the colours of the pupæ of the *Pieridæ*, by means of papers of various colours, the results were so astonishing that it was in every way satisfactory to have them confirmed. Special interest attached to the colour-

* A diagram was exhibited.

effects of the orange, yellow and green parts of the spectrum. The predominance of rays from this region in the light incident upon the larva before pupation hindered the formation of dark pigment, and tended towards the production of green varieties of the pupa. But it was very remarkable that the orange and yellow light produced stronger effects in both these directions than the green itself. It seemed probable that the explanation might be found in the theory that the orange and yellow rays existing in the impure mixed greens found in Nature were the really efficient stimuli which produced effects of protective resemblance to the green colour itself. Mr. Poulton said he had suggested this explanation when he published the account of his experiments; but it was very satisfactory to find the explanation further supported by Mr. Griffiths' facts. Mr. Griffiths' yellow paper also produced much stronger effects than the green paper used by him. The extremely sensitive nature of the larvæ before pupation was shown by the marked effects following from the pale tissue paper used by Mr. Griffiths. In his (Mr. Poulton's) experiments much stronger colours were employed, so that the test of larval susceptibility was not nearly so severe.

Mr. Poulton further said that as we now know that the colour-influence is efficient for many hours of the period before pupation, and that it probably ceases for most of the third stage when the larva is motionless and fixed by the silken girdle and anal pad, it is clear that Mr. Griffiths' experiments with particoloured surroundings did not afford any true test of the effects of such a stimulus; for his colours were applied during the third stage only, and without special care to ensure their application as early as possible in the period. In view of statements about parti-coloured pupæ found upon red brick and grey mortar, and considering Mr. Barker's observation of a parti-coloured pupa of *Papilio niveus* supposed to result from the effects of brick and wood, it would be well to test the *Pieridæ* thoroughly with two colours producing as opposite an effect as possible. Black and orange would be the best colours for the purpose, and a box might be lined with a small chess-board pattern of those colours, the squares being so small that a larva would be compelled

to rest upon two squares at the same time. Thus the conflicting colours would operate during the second and third stages. Mr. Poulton said he hoped to make such an experiment during the present season, and he should be extremely glad if others would do the same. In conclusion he remarked that the thanks of the Society were certainly due to Mr. Griffiths for his careful experiments, and to Mr. White for the trouble he had taken in arranging and bringing out the notes.

Lord Walsingham observed that pigment took longer to form when the surroundings are dark than when they are light; and that dark colours absorb and radiate heat more than light colours.

Mr. Jacoby, Dr. Sharp, Mr. White, and others continued the discussion.

April 4, 1888.

Dr. David Sharp, F.L.S., F.Z.S., President, in the chair.

Donations to the Library were announced, and thanks voted to the respective donors.

Election of Fellows.

The Rev. J. H. Hodson, B.A., of Torquay, Devon; Mr. A. J. Croker, of New Cross, S.E.; Mr. G. C. Griffiths, of Cotham, Bristol; and Mr. Albert H. Jones, of Eltham, Kent, were elected Fellows.

Exhibitions, &c.

Mr. H. Goss exhibited a large number of insects lately received from Baron Ferdinand von Mueller, K.C.M.G., F.R.S., of Melbourne, which had been collected by Mr. Sayer on Mount Obree and the adjoining ranges in New Guinea, during Mr. Cuthbertson's recent expedition there under the direction of the Royal Geographical Society of Australia. The collection comprised about 240 species of Coleoptera, 150 species of Lepidoptera, 48 species of Hemiptera, and a few species of Diptera, Hymenoptera and Orthoptera. The Lepidoptera included twenty species of butterflies, viz.:—*Calliploea Saundersii* (Felder), *Chanapa angusii* (Felder), *Hama-*

dryas Moorei (McLeay), *Melanitis Solandra* (Fabr.), *Mycalesis cacodæmon* (Kirsch.), *Hypocysta Osiris* (Boisd.), *Tenaris onolaus* (Kirsch.), *T. bioculatus* (Guér.), *Hypolimnas deois*, male (Hewits.), *H. nerina*, male (Fabr.), *Cyrestis achates* (Butler), *Neptis venilia*, var. (Linn.), *N. praslini* (Boisd.), *Acræa andromacha* (Fabr.), *Lampides nemophila*, female (Butler), *Danis Sebæ*, male (Westwood), *Pithecops dionysius* (Boisd.), *Appias delicata* (Butler), *Ornithoptera pronomus* (Gray), *Eurycus troilus* (Butler). Mr. Goss said he had to express his thanks to Mr. Arthur G. Butler, and Mr. W. F. Kirby, of the British Museum, for their assistance in comparing the specimens with types in the National Collection, and identifying the species.

Mr. Osbert Salvin, F.R.S., exhibited, and made remarks on, about sixty specimens—no two of which were alike—of a species of butterfly belonging to the genus *Hypolimnas*, all of which had been caught by Mr. Woodford near Suva, Viti Levu, Fiji, on one patch of Zinnias.

Mr. H. T. Stainton, F.R.S., exhibited, on behalf of Mr. G. C. Bignell, cases of *Thyridopteryx ephemeræformis*, Haworth, collected near Charleston, U.S.A. Mr. Stainton said he hoped Mr. Bignell would not introduce this pest into England.

Mr. W. F. Kirby exhibited about twenty species of South African dragonflies lately received from Mr. Roland Trimen, F.R.S., of Cape Town. Mr. Kirby said the collection included several species unrepresented in the National Collection, some of which were probably new to Science.

Mr. A. Sich exhibited a bred specimen of a variety of *Plusia gamma*.

Mr. Goss read the following letter from Mr. Bignell, correcting a statement made by Mr. Poulton at the March meeting of the Society, to the effect that the variety *Valezina* of the female of *Argynnis paphia* did not occur in Devonshire:—

"7, Clarence Place, Stonehouse, Devon,
"24th March, 1888.

"Dear Sir,—On reading the 'Proceedings' of the 7th inst., I see Mr. Poulton is reported to have said that the typical form of *Argynnis paphia* 'was excessively abundant in Devonshire, and yet the *Valezina* form had *never been seen there*.'

I cannot understand how a gentleman of Mr. Poulton's reputation could have made such an assertion without first making some inquiry of those who are connected with the district. Two lists of the Lepidoptera of Devonshire have been published: the first (part 1, 1862; part 2, 1863; the last 1865, to the end of the Noctuæ) by 'The Council of the Plymouth Institution and Devon and Cornwall Natural History Society,' compiled by J. J. Reading, of Plymouth; the second, 1878, written by E. Parfitt, of Exeter, and published by 'The Devonshire Association.' In both of these lists mention is made of the capture of *Valezina* in Bickleigh Vale. I have also taken it in that locality, and at the present moment possess two specimens captured there. If you will kindly make this correction in your next issue of the 'Proceedings,' I should feel obliged.

"I am, Dear Sir, Yours truly,

"H. Goss, Esq., "G. C. Bignell.

"Secretary of the Entomological Society."

Mr. Goss read the following letter from Mr. E. C. Cotes, of the Indian Museum, Calcutta, asking for the assistance of British Entomologists in working out certain groups of Coleoptera, Neuroptera, Orthoptera, Diptera, and Hymenoptera in the Indian Museum:—

"Indian Museum, Calcutta,

"1st March, 1888.

"Dear Sir,—I venture to ask for your assistance in the following matter. The rough arrangement of the fine collections of insects in the Indian Museum of Calcutta is fairly complete. But to make these collections, and especially the specimens which are connected with Economic Entomology, of real value to the people of India, more precise determination is necessary than can be attempted in the absence of type-specimens. I therefore venture to ask you to assist me in making known to the entomologists of your Society—some of whom may be in want of material for working at the special groups of insects in which they are interested—that the Indian Museum contains large collections of insects from all parts of India, besides Burmah, the Andaman Islands, and

Ceylon; and that help is asked for, in determining them, in exchange for the duplicates which the Museum contains. Help is specially needed in the case of the groups Coleoptera, Neuroptera, Orthoptera (except *Mantidæ*), Diptera, and Hymenoptera (except *Formicidæ*). Communications on the subject addressed to me at the Indian Museum, Calcutta, will in all cases be acknowledged, and any assistance in my power gladly given.

"Yours faithfully,

"E. C. Cotes.

"To the Secretary of the Entomological Society of London."

Mr. McLachlan, F.R.S., Dr. Sharp, Mr. Waterhouse, Mr. Jacoby, and Mr. Distant took part in the discussion which ensued.

Papers, &c., read.

Mr. Kirby read the following Notes on the Dragonflies exhibited by him:—

The collection includes about twenty species in all, belonging to five subfamilies. The *Libellulidæ* (subfamily *Libellulinæ*) are represented by eight species.

1. *Pantala flavescens*, Fabr., a cosmopolitan species.

2–4. The characteristic African genus *Palpopleura* is represented by three species; the common and widely-distributed *P. lucia*, Dru. (male, female), and *P. portia*, Dru. (male), and the S. African *P. jucunda*, Ramb. The series of the latter is interesting, as it includes both the mature and immature male, as well as the female.

5. *Trithemis arteriosa*, Burm., and 6. *Crocothemis erythræa*, Brullé, both widely distributed in Africa, and the latter extending to the South of Europe and Asia.

7, 8. *Orthetrum fasciolatum*, Ramb. (female), and *O. subfasciolatum*, Brauer (male, female), two closely allied S. African species.

9, 10. The *Æschnidæ* (subfamily *Gomphinæ*) are represented by two species, probably new.

11, 12. The *Æschnidæ* (subfamily *Æschninæ*) are also represented by two species; the common *Anax mauricianus*, Ramb., and a new species of *Æschna*, which will, I presume, be

described by Baron de Selys-Longchamps in his forthcoming synopsis of the subfamily.

13. There is only one species of *Agrionidæ* (subfamily *Calepteryginæ*). It belongs to the curious African genus *Libellago*, in some of which the tibiæ are broadly dilated, as in *Platycnemis*. The present specimen appears to be the male of an insect which has hitherto stood in the British Museum as the female of *L. caligata*, De Selys; but I suspect that a series would show that it was distinct.

Among the *Agrionidæ* (subfamily *Agrioninæ*) I find the following species:—

14. *Chlorolestes tessellata*, Burm. (male).

15. *C. conspicua*, De Selys (male, female).

16. *Allocnemis leucosticta*, De Selys (male).

Three well-known S. African species; the first remarkable for its banded wings, and very similar in size and general appearance to *Calepteryx virgo*, L.; the last distinguished by the curious white stigma.

17. *Disparoneura*, a new species, differing in neuration from any noticed by De Selys, as the upper section of the triangle extends on the fore wings for four cells beyond the nodus, and on the hind wings for three.

18–20. One or two small species allied to *Agrion* of authors, which may or may not be new.

Mr. Waterhouse read a paper entitled "Additional Observations on the Tea-bugs (*Helopeltis*) of Java," and exhibited a number of specimens of these insects. He said that the species infesting the Cinchona in Java was supposed to have been introduced from Ceylon in tea, but that he had discovered that the species on the Tea and on Cinchona in Java were distinct, and that both species were distinct from *Helopeltis Antonii* of Ceylon.

Mr. Jacoby read a paper entitled "New, or little-known, species of Phytophagous Coleoptera from Africa and Madagascar."

May 2, 1888.

Dr. David Sharp, F.L.S., F.Z.S., President, in the chair.

Donations to the Library were announced, and thanks voted to the respective donors.

Election of Fellows.

Major J. W. Yerbury, R.A., of the Army and Navy Club, Pall Mall, S.W.; and Mr. P. W. Mackinnon, of the Old Brewery, Masuri, Western Himalayas, India, were elected Fellows.

Exhibitions, &c.

Dr. P. B. Mason exhibited an hermaphrodite specimen of *Saturnia carpini* from Lincoln, and another specimen of the same species with five wings, bred at Tenby.

Mr. Jacoby exhibited specimens of *Chrysomela japana*, collected by Mr. J. H. Leech in Japan, and called attention to a sexual structure in the middle of the abdominal segment.

Mr. Adkin exhibited a variety of *Eubolia bipunctaria*, taken at Box Hill, in July, 1886.

Mr. W. F. Kirby exhibited, for Dr. Livett, a curious discoloured female specimen of *Ornithoptera minos*, Cramer.

Mr. H. Goss exhibited, for Mr. W. Denison-Roebuck, a number of specimens of an exotic species of Bee obtained by the Rev. W. Fowler, of Liversedge, from split logwood. The cells or pouches were very irregular and rough, and altogether unlike those in the "comb" of any known British species of Bee or Wasp.

Dr. J. W. Ellis exhibited a number of specimens and drawings of *Aphodius melanostictus*, Schmidt, and of *Aphodius inquinatus*, F.

Papers read.

Dr. Ellis read the following paper: "On the British specimens of (so-called) *Aphodius melanostictus*, Schmidt":—

On the last page of the fifteenth volume of the 'Entomologists' Monthly Magazine' Mr. E. C. Rye introduces, as new to the British insect fauna, an *Aphodius* under the name of *melanostictus*, Schmp. (= Schmidt, Er.), specimens of which

had been sent to him by Mr. Joseph Chappell, of Manchester, who had collected them in that district, and who at the time believed them to be a form of *Aphodius inquinatus*. Mr. Rye remarks:—" Compared with *inquinatus*, the majority are conspicuously larger, with more developed limbs, and the ground colour of a darker testaceous colour, *the sides of the thorax entirely reddish testaceous*, and the black streak in the second interstice of the elytra reaching farther towards the middle. In all but one of my specimens, also, the black line connected with this streak is carried towards the apex and connected in the lower third with the lateral black line, which is not the case in any of my varieties of *inquinatus*."

Aphodius inquinatus is a very abundant insect on the coast sandhills of Lancashire and Cheshire, and I had for some time in my collection two specimens which I referred to its var. *centrolineatus*, Panz., but on sending one of these to the Rev. Canon Fowler he informed me that the specimen was one of *A. melanostictus*. Although my remaining specimen agreed with the description given above by Rye, I could find no structural difference between it and *inquinatus*, and I have had it in my cabinet as *melanostictus* only under protest.

I have recently had an opportunity of examining Mr. Chappell's specimens of *A. melanostictus*, and have carefully compared them not only with the description of that and allied species of *Aphodius* in Mulsant and Rey's 'Coleoptères de France,' but also with undoubted specimens of *A. melanostictus* obtained from Herr Reitter, of Vienna.

There is a great general resemblance between the two species, and though Rye italicises the remark that in *melanostictus* the sides of the thorax are entirely reddish testaceous, which is the case in typical specimens (except that there is a distinct black spot in the centre of the side, as in our *A. sordidus*), yet, since I have specimens of this species which have the sides of the thorax obscure, and also specimens of *inquinatus* which have the whole side of the thorax bright testaceous-red, this character cannot be considered as of any value for diagnosis.

If we compare specimens of *A. melanostictus* with ordinary

specimens of *A. inquinatus*, we find a difference in the disposition of the elytral spots:—

(1) In *melanostictus* the anterior internal group (or spot) is situate at the junction of the anterior *third* with the remainder of the elytra. In *inquinatus* this group is evidently much nearer the base, at the junction of the anterior *fourth* with the rest of the elytra.

(2) The anterior internal spot in *melanostictus* consists of a square or oblong (always rectangular) spot in the third interstice, with frequently a similar spot, joined to it, in the fourth interstice, but never any spot or mark in the second interstice. In *inquinatus* this group consists of two irregularly shaped united spots in the third and fourth interstices and, usually, one in the second interstice.

(3) In *inquinatus* there is a tendency for the posterior group of spots to become united in an arched manner, and with a streak from the side to form an annulus, which, with the one of the opposite side and the dark suture between, sometimes gives rise to a grotesque resemblance to a face. In *melanostictus* there is never any trace of such annulus.

By far the most important point of difference between the two species lies in the condition of the lozenge-shaped metasternal plate of the male, but the distinction is confined to that sex. In male *melanostictus* this plate is extremely finely punctured, and completely destitute of hair. In male *inquinatus*, which alone among this group of the genus possesses this character, the metasternal plate is thickly and deeply punctured, and distinctly hairy.

On submitting my own specimens, and those of Mr. Chappell, of the (so called) *Aphodius melanostictus* to a careful examination, and more especially after examining a number of males and comparing them with males of *inquinatus* and of *melanostictus*, I find that they most distinctly agree with the former in having the metasternal plate densely punctured and hairy; therefore, taking this character together with the fact that specimens having their character of elytral marking have been already described by Mulsant as varieties of *inquinatus*, I feel justified in asserting that the British specimens of so-called *Aphodius melanostictus* are but varietal forms—

produced by elongation and coalescence of the elytral spots—of the protean *Aphodius inquinatus*, and that the true *Aphodius melanostictus* has yet to be found in Britain.

Dr. P. B. Mason, Mr. Champion, Dr. Sharp, and Dr. Ellis took part in the discussion which ensued.

Mr. E. Meyrick communicated a paper "On the Pyralidina of the Hawaiian Islands," the materials for which paper consisted principally of the collection of Lepidoptera Heterocera formed by the Rev. T. Blackburn during six years' residence in the Hawaiian Islands. Mr. Meyrick pointed out that the exceptional position of these islands renders an accurate knowledge of their fauna a subject of great interest. He stated that of the fifty-six known species of Hawaiian Pyralidina nine had probably been introduced through the agency of man in recent times; but he believed the remaining forty-seven to be wholly endemic: of these latter the author referred twenty-six species to the *Botydidæ*, twelve to the *Scopariadæ*, four to the *Pterophoridæ*, three to the *Crambidæ*, and two to the *Phycitidæ*.

Dr. Sharp, Mr. McLachlan, Dr. Mason, and Mr. E. B. Poulton took part in the discussion which ensued.

June 6, 1888.

Dr. David Sharp, F.L.S., F.Z.S., President, in the chair.

Donations to the Library were announced, and thanks voted to the respective donors.

Election of a Fellow.

Mr. George Meyer D'Arcis, of 32, Central Hill, Upper Norwood, was elected a Fellow.

Exhibitions, &c.

Mr. Pascoe brought for exhibition a book of fine plates of *Mantidæ*, drawn by Prof. Westwood, which it had been hoped would have been published by the Ray Society.

Mr. E. Saunders exhibited a species of Hemiptera, *Monanthia*

angustata, H.-S., new to Britain, which he had captured by sweeping near Cisbury, Worthing. The insect is rather closely allied to the common *Monanthia cardui*, L.

Mr. M'Lachlan exhibited a species of *Halticidæ*, which had been sent to him by Mr. D. Morris, Assistant-Director of the Royal Gardens, Kew, who had received them from Mr. J. H. Hart, of the Botanic Gardens, Trinidad, with a note to the effect that they had attacked young tobacco- and egg-plants badly in that island. Mr. Jacoby had, with some reserve, given as his opinion that it might possibly turn out to be *Epitrix fuscata*, Duv., a species which had been described from Cuba.

The Rev. H. S. Gorham exhibited a number of beetles lately captured in Brittany, including *Diachromus germanus*, L., *Onthophagus taurus*, L., *Hister sinuatus*, Ill., and other species which are exceedingly rare, or altogether wanting in Britain, and yet occur very commonly in the North of France.

Mr. Enock exhibited specimens of the Hessian Fly bred by himself and mounted for the microscope.

Mr. W. White exhibited, on behalf of Mr. G. C. Griffiths, two living larvæ of *Endromis versicolora* in their third stage, illustrating their strongly protective resemblance to the catkins and leaves of their food. Mr. Griffiths had noticed it to be the habit of the insect at this period to congregate at the ends of the twigs of birch, with their heads nearly always in the direction of the end of the spray: in their favourite resting attitude, in which the fore part of the body was elevated at a curve, they bore a great similitude to the young catkins. On more than one occasion he had also noticed, when feeding a number of them, that one or two ejected from the mouth a greenish fluid, which he concluded to have a protective value, and to be produced under sudden alarm; but he had not been able to induce them to repeat the act. It was, however, a common habit for them to swerve their heads sharply round in a threatening manner whenever the anal hump was touched. As the specimens exhibited had just passed out of the second stage, they had lost the character of chief interest in their ontogeny, for in

the earlier stages the larval surface is densely covered with minute black specks, rendering it almost black in appearance, with a continuous black dorsal line. By way of illustration Mr. White showed some preserved specimens of the larva in the second stage, which are not often to be seen in this state, together with a fully-matured specimen.

Mr. White also exhibited two preserved larvæ of the "Essex Emerald Moth," *Phorodesma smaragdaria.* He had recently, in company with Messrs. Fitch, Harwood, and others, succeeded in obtaining several of these curious larvæ near Brightlingsea on the Essex coast. The larval form of this insect had only lately become fully known, and it was well to preserve it with care, as otherwise collectors would soon exterminate it. Mr. G. Elisha had exhibited living examples of it at a meeting of the Society two years ago, when he first published many interesting particulars of its life-history (Trans. Ent. Soc. Lond., 1886, pp. 465–468), and Mr. William Cole had recently drawn up a full historical account of the species as known in England, which appeared in 'The Essex Naturalist' for June, 1887. Mr. White wished to correct two errors which had been made in descriptions of the larva which had been given in various text-books. It had been wrongly described as living in a case formed from its food-plant, whereas its habit is to cover itself with pieces of its food by a special means, the particles being bitten off apparently in order to enable it completely to resemble its food-plant. It was quite true that these particles adhere to the surface of the larva by means of a sticky exudation, as stated by Mr. Elisha, but the end is attained by the highly special method of actual *excretory glands*, which are developed irregularly upon various segments of the body. These glands are seen, by means of a good lens, to be prominent elongate processes, of an almost pure white colour, each bearing at the top a single, rather long, stiff hair, which doubtless serves to spike the fleshy substance of the *Artemisia:* sketches were shown in illustration of this point. Although no result could be produced artificially by applying gentle pressure externally to a gland, there could be no doubt that they possess the functional value claimed for them, as evidenced

by the presence of the fine dusty particles and large pieces of leaf firmly attached to them. The gummy exudation, whatever its nature as a product may be, possesses a tenaciousness so extreme that none of the particles were in the least disturbed in the preserving process, although the glandular protuberances were considerably flattened by the rolling. Mr. White also stated that there are not any particular "humps" upon certain segments, as had been stated in some descriptions, unless the small glands just noticed are intended, which is improbable; the skin, however, is much wrinkled in the subspiracular region, forming an irregular and somewhat flattened fringe upon the sides of the anterior segments, adding greatly to the general protective resemblance of the larva to its food-plant. It was, moreover, interesting to find that this species,—so highly protected, as it is, that it requires long and patient searching to discover any larva whatever,—is much subject to the attack of enemies, as evidenced by the appearance of several parasitic flies, which Mr. White included in the exhibition, illustrating the fact that the more an organism is liable to danger the more will it develop, under natural selection, protective devices which will be proportionate to, and in direct relation with, the attacks of its foes, with the effect of becoming more specialised. With regard to the generic name, the insect had generally been referred to under the common term *Geometra* (of Linnæus and Boisduval), while in Curtis's 'British Entomology,' 1830, vol. vii., it is figured (pl. 300) under the name *Hipparchius smaragdarius*; but the consensus of opinion is in favour of that recognised on the Continent, viz., *Phorodesma* (Boisd.) *smaragdaria* (Fab.).

Mr. Lewis exhibited about three hundred specimens of the genera *Hetærius*, Er., and *Eretmotes*, Mars. The most remarkable of these was *Hetærius acutangulus*, Lewis, discovered last year by Mr. J. J. Walker near Tangier, and recently taken by him at S. Roche, in Spain. The names of the other species exhibited are:—*Hetærius bedeli*, Lewis, *H. punctulatus*, Lucas, *H. comosellus*, Fairmaire, *H. pluristriatus*, Fairmaire, *H. setulosus*, Reitter, *Eretmotes sociator*, Fairmaire, from Algeria. *Hetærius acutangulus*, Lewis, *H.*

arachnoides, Fairmaire, *H.* ——, n. s., *Eretmotes tangerianus*, Marseul, from Morocco. *Hetærius hispanicus*, Rosenh., *H. marseuli*, Brisout, *Eretmotes ibericus*, Brisout, from Spain, and *Hetærius ferrugineus*, Oliv., from France.

July 4, 1888.

Dr. David Sharp, F.L.S., F.Z.S., President, in the chair.

Donations to the Library were announced, and thanks voted to the respective donors.

Election of a Fellow.

The Hon. Lionel Walter de Rothschild, of 148, Piccadilly, and Tring Park, Tring, Hertfordshire, was elected a Fellow of the Society.

Exhibitions, &c.

Mr. Enock exhibited male and female specimens of a spider received from Col. Le Grice, R.A., who had captured them at Folkestone in May last. They had been submitted to the Rev. O. Pickard-Cambridge, F.R.S., who identified them as *Pellenes tripunctatus* or *P. cruciger us* (described under both names by Walckenaer), which had not been hitherto recorded as occurring in Great Britain. Mr. Enock said this spider was first seen on May 27th by Master W. Kerr, who pointed it out to Col. Le Grice, and he captured it; a female was next seen by Mr. Kerr, sen., and captured by Col. Le Grice. The males of this beautiful spider are found during the brightest sunshine, sitting on bits of chalk scattered about on sloping banks facing south; the female is more retired in her habits. The bright scarlet hairs which surround the four anterior eyes of the male make this spider the most strikingly beautiful of all the British *Salticidæ*.

Mr. Enock also exhibited specimens of *Merisus destructor* (Riley), an American parasite of the Hessian Fly, bred from British specimens of that insect. He said that in the autumn of 1887 he bred between fifty and sixty parasites of the Hessian Fly from puparia collected on the 5th and 8th of August, four

of which appeared to him to agree with Prof. Riley's description of *Merisus destructor* given in his pamphlet on 'The Parasites of the Hessian Fly.' Mr. Enock said his opinion was further strengthened by that of Dr. Lindeman, who identified some Russian species from examples sent to him by Miss E. A. Ormerod. Mr. Enock further stated that during May and June he had bred a very large number of various parasites from puparia; amongst them were about a hundred specimens of the one which he was inclined to think was *Merisus destructor*, specimens of which he sent (alive) to Dr. Lindeman, who, in his reply, states that "The specimens of parasites sent, bred in England from the Hessian Fly, seem to me to be *Merisus destructor* of Riley; they differ from my *M. intermedius* by the more compressed and broader shape of the body in the female, by their less intense green lustre, and by the brown or almost black antennæ." Mr. Enock also said that he had bred several specimens of another parasite, which he is inclined to think will prove to be identical with *Platygaster herrickii* of Riley, and, should this be correct, it suggests that some of the attacks of Hessian Fly may have come from America.

Mr. Wallis-Kew exhibited a number of larvæ of *Adimonia tanaceti* (Fab.), found in Lincolnshire, feeding on Scabious.

Mr. Porritt exhibited a number of variable specimens of *Arctia mendica*, bred from a batch of eggs found last year on a species of *Rumex* at Huddersfield. Mr. Porritt said that this species, in the neighbourhood of Huddersfield, was often more spotted than the typical form, but he had never before seen anything approaching in extent the variation exhibited in these bred specimens. Out of forty-four specimens (twenty-five males and nineteen females) not more than eight were like the ordinary type of the species.

Mr. M'Lachlan exhibited specimens of *Palingenia longicauda* (in alcohol) from Holland—the largest of the European *Ephemeridæ* (May-flies), and at the same time one of the most local.

Mr. Jacoby exhibited the following species of Phytophagous Coleoptera from Africa and Madagascar, recently described by him in the 'Transactions' of the Society, viz.:—*Lema laticollis*, *Cladocera nigripennis*, *Oedionychis madagascariensis*, *Blepharida intermedia*, *B. nigromaculata*, *Chrysomela madagascari-*

ensis, *Sagra opaca*, *Blepharida ornaticollis*, *B. laterimaculata*, *Mesodonta submetallica*, *Schematizella viridis*, *Spilocephalus viridipennis*, *Apophylia smaragdipennis*, and *Aethonea variabilis*.

Mons. Alfred Wailly exhibited a large number of species of Lepidoptera and Coleoptera, recently received by him from Assam, from the West Coast of Africa, and from South Africa; also a large and brilliant locust from Accra, West Coast of Africa. He also exhibited eggs and living larvæ of *Bombyx cytheræa*. He stated that ova of *B. cytheræa* sent to him on the 16th of April arrived on the 8th of May; fifty-seven hatched on the day the box arrived, and a batch of forty eggs, all laid on the same leaf, hatched on the 18th of May, ten days later than the others. The larvæ, after being offered various kinds of foliage, were ultimately fed on plum alone. They were very slow in growing, and, with few exceptions, they died. The larvæ of the batch of forty all hatched on the morning of the 18th of May; they reached their second stage on the 5th of June, and the third stage on the 26th of June. The larvæ in the first stage are red, with black shining head, black legs, and black tubercles round each segment; second stage, the larvæ are of a light buff-colour, head black, tubercles black, covered with white hairs. In the third stage the larvæ are of a light red, but in other respects the third stage resembles the second stage.

August 1, 1888.

Dr. David Sharp, F.L.S., F.Z.S., President, in the chair.

Donations to the Library were announced, and thanks voted to the respective donors.

Election of a Fellow.

The Rev. A. Walton Lewis, B.A., of Kamastone, Cape Colony, was elected a Fellow of the Society.

Exhibitions, &c.

Mr. F. Du Cane Godman, F.R.S., exhibited a large number of species of Lepidoptera and Diptera recently collected for him in Mexico by Mr. Herbert Smith.

Mr. White exhibited parasites bred from *Bombyx neustria*, and a living example of *Hetrodes guyoni*, found at Dartford, and believed to have been introduced with Esparto grass from Tunis.

Mr. Enock exhibited a stem of barley, showing the appearance of the plant under an attack of Hessian Fly.

Mr. Samuel Stevens exhibited a number of galls collected at Byfleet, Surrey, in July last, by Mr. Leonard Stevens; also a specimen of *Coleophora solitariella*, with ichneumons bred from it.

Mr. Edward Saunders exhibited a specimen of *Catephia alchymista*, captured by his son at St. Leonards, in June last. He also exhibited specimens of a rare Ant (*Anochetus ghiliani*), taken at Tangier by Mr. G. Lewis. One of these he had submitted to Dr. Emery, of Bologna, who thought that, although ocelli were present, the specimen was probably intermediate between a worker and a female, and that possibly the true female did not exist.

Mr. Pascoe exhibited a number of species of *Coleoptera* recently collected in Germany and the Jura Mountains, and read a note correcting the synonymy of certain species of *Brachycerus* recently described and figured by him in the 'Transactions' of the Society. He stated that the following corrections had been suggested by Mons. Péringuey and Mons. Aurivillius:—*Brachycerus cinnamonomeus* = *annulatus*, Gerst.; *B. suturalis* = *eckloni*, Gyll.; *B. capito* = *stellaris*, Ol., *fasciculosus*, Germ., *apicatus*, Gyll. (all vars. according to Péringuey); *B. faustii* = *oblongus*, ♀, Fåhr.; *B. precursor* = *oblongus*, ♂, Fåhr.; *B. electilis* = *sculpturatus*, Fåhr.; *B. draco* = ? *impressicollis*, Péringuey.

Paper read.

Prof. Westwood communicated a paper entitled "A List of the Diurnal Lepidoptera collected in Northern Celebes by Dr. Sydney Hickson, with descriptions of New Species."

September 5, 1888.

Dr. DAVID SHARP, F.L.S., F.Z.S., President, in the chair.

Donations to the Library were announced, and thanks voted to the respective donors.

Election of a Fellow.

Mr. M. Stanger Higgs, of the Mill House, Upton St. Leonard's, Gloucestershire, was elected a Fellow of the Society.

Exhibitions, &c.

Dr. Sharp mentioned that he had received, through Prof. Newton, F.R.S., a collection of Coleoptera from St. Kilda, consisting of *Carabus catenulatus* (1), *Nebria brevicollis* (12), *N. gyllenhalii* (3), *Calathus cisteloides* (20), *Pristonychus terricolla* (1), *Pterostichus nigrita* (71), *P. niger* (31), *Amara aulica* (4), *Ocypus olens* (1). The species being nearly all large Geodephaga, he thought it probable that many other Coleoptera inhabited the island. He remarked that these specimens showed no signs of depauperation, but were scarcely distinguishable from ordinary English specimens.

Mr. South exhibited a melanic *Aplecta nebulosa* from Rotherham, bred with five others of ordinary form, and an albino of the same species from Devonshire; a very curious dark variety of *Plusia gamma;* two dark vars. of *Eubolia limitata* from Durham; and *Dicrorhampha consortana* from North Devon.

Mr. Champion exhibited *Harpalus cupreus*, *Leptusa testacea*, and *Cathiomocerus socius* from Sandown, Isle of Wight.

Mr. Elisha exhibited the following Tortrices :—*Argyrolepia æneana*, *A. zephyrana*, *Eupœcilia atricapitana*, *E. amandana*, *Retinia turionana*, *Catoptria juliana*, *Phoxopteryx derasana*, *Ephippiphora trigeminana*, and *Carpocapsa pomonella*, the last-named bred from berries of the white beam-tree; also the following Tineæ :—*Nematois fasciellus*, *Cerostoma horridella*, *C. alpella*, *Œcophora unitella*, *Coleophora therinella*, and *Gelechia semidecandrella*, the last-named bred from *Cerastium tetrandrum*.

Mr. Jacoby exhibited three boxes of Coleoptera, containing some rare *Cetoniadæ*, *Paussidæ*, &c., collected by Mr. Frühstroffer.

Mr. E. Saunders exhibited *Amblytylus delicatus*, Perr., a new British bug, taken at Woking.

Mr. Jacoby mentioned that he had taken the larva of *Vanessa cardui* on a narrow-white-leaved plant in his garden.

Mr. Enock stated that out of a batch of two males and six females of the Hessian Fly kept together, all six females had laid fertile eggs, so that each male must have impregnated more than one female.

October 3, 1888.

Dr. David Sharp, F.L.S., F.Z.S., President, in the chair.

Donations to the Library were announced and thanks voted to the respective donors.

Exhibitions, &c.

Mr. F. P. Pascoe exhibited a number of new species of *Longicornia* from Sumatra, Madagascar, and South Africa.

Dr. P. B. Mason exhibited, for Mr. Harris, a specimen of *Chærocampa nerii*, recently captured at Burton-on-Trent.

Mr. S. Stevens exhibited a specimen of *Vanessa antiopa*, which he caught in the Isle of Wight in August last. Mr. Stevens asked whether Mr. Poulton or any one else present could inform him why, in British specimens of this species, the border of the wings was almost invariably a pale straw-colour. A discussion ensued, in which Mr. F. D. Godman, Mr. M'Lachlan, Mr. Kirby, and Dr. Mason took part.

Mr. E. B. Poulton exhibited a living larva of *Smerinthus ocellatus* in the last stage, which had been hitherto fed upon nut—an entirely new food-plant. Thirty eggs had been put upon the plant, but only two of the larvæ would eat it; of these one died at the beginning of the last stage. Mr. Poulton said the result was very interesting, as a further proof that the specialization of larvæ to certain food plants largely grows up in the life of the individual, the young larva being *comparatively* free to choose. *Smerinthus ocellatus* is a very specialized larva, and is *never* found on more than two or three species of food-plant; hence the fact that over 6 per

cent. of the larvæ could eat an entirely new plant was of great significance, and much helped to explain the changes which must have occurred during the spread of these insects into countries with a different flora. He also exhibited fourteen larvæ of *Boarmia roboraria*, of which seven had been surrounded by oak-leaves and green twigs, while the other seven had been surrounded by many brown twigs, in addition to the food; the latter became dark brown, but the former were without any exception much lighter. Mr. Poulton further exhibited some cocoons of *Rumia cratægata*, the colours of which had been influenced by their surroundings. He observed that on a previous occasion, when he had exhibited the cocoons of *Eriogaster lanestris* and of *Halias prasinana*, it had been remarked that the larvæ should be exposed to some permanent green colour during the construction of their cocoons, in order to test whether the same results would be produced as those which followed the presence of green leaves. The latter produced brown cocoons, and this result is protective, because the leaves turn brown, and so the cocoons are in contact with a surface with which they harmonize in colour; but of course the change in the colour of the leaf takes place long after the cocoon is constructed. Mr. Poulton had argued that the permanent green colour would produce the same effect as the leaves, *if it afforded stimulus which sufficiently resembled that of the latter in character*, while the converse supposition, that the larvæ spun the brown cocoons from choice, and because of their knowledge of the subsequent changes which the leaf would undergo (long after their pupation), seemed to him to be on the face of it utterly untenable. And so the cocoons of *Rumia cratægata* had proved it to be, for some of them were spun upon green paper, and these were (with one exception) light brown in colour, like those spun among leaves, while the cocoons spun against white muslin were quite white.

Mr. M. Jacoby exhibited a varied series of *Titubæa sanguinipennis*, Lac., from Central America. He stated that many of the varieties exhibited had been described as distinct species.

Mr. Billups exhibited specimens of *Bracon brevicornis*, Wesm., bred from larvæ of *Ephestia kuhniella*. He remarked

that this rare species had only been recorded as bred on four previous occasions, *viz.*, by the Rev. T. A. Marshall, who got three females from galls of *Andricus terminalis*, Fab., obtained near London; in October, 1884, Mr. W. F. Kirby succeeded in breeding six males and one female from *Ephestia elutella*, Hub.; Brischke obtained one male from *Dioryctria abietella*, Zinck.; while Mr. Sydney Webb, of Dover, succeeded in rearing another male on August 10th, 1884, from a larva of *Myelois ceratoniæ*, Zell.

Mr. W. Warren exhibited specimens of *Antithesia ustulana* and *A. fuligana;* also bred series of the following species:— *Eupœcilia degreyana*, *Stigmonota pallifrontana*, *Cacœcia decretana*, and *Gelechia peliella.*

Lord Walsingham exhibited specimens of several species of the genus *Cryptophasa* belonging to the family *Cryptolechidæ* of the Tineina, some of the most remarkable being males and females of *Zitua balteata*, Walker, bred by Mr. Sidney Olliff, from pupæ found in January last, at Newcastle, New South Wales, in burrows in branches of a species of Acacia. Lord Walsingham also exhibited a male specimen of *Zelotyphia stacyi*, received from Mr. Olliff.

Mr. F. D. Godman exhibited a larva of a *Cicada*, from Mexico, having a fungoid growth on the head.

Messrs. F. D. Godman and H. J. Elwes exhibited a collection of butterflies, including upwards of a hundred species, made by them in California during the month of May, and in the Yellowstone Park, Wyoming, during a few days in the beginning of June. Mr. Elwes remarked that many of the species were of considerable rarity and interest, especially those taken in the Yellowstone Park, which appears to have been but little worked by American entomologists. Among those from Southern California were the lovely *Lycæna sonorensis*, Feld., a species which, though local, is not so rare as has been supposed, and has been bred from the larva recently by Mr. Wright, of San Bernardino. It has usually been taken in early spring, in warm situations on the coast of Southern and Lower California, but was found by Messrs. Godman and Elwes in the open pine forest on the San Bernardino Mountains, at an elevation of about 4000 feet.

A considerable series of specimens of *Colias chrysotheme*, with its varieties *ariadne*, *keewaydin*, and *eurytheme* were shown, in order to prove that though these seasonal forms are characteristic of particular seasons as a rule, yet that they are also to be found in many cases out of season. For instance, among several pairs of typical *C. ariadne* (which is the winter brood in the southern and warmest parts of the United States), taken at New Orleans, in Louisiana, a few of *keewaydin* occurred, and amongst numerous specimens of *keewaydin* taken at San Bernardino in May, were some of the larger and more brilliantly coloured *C. eurytheme*, which is the summer and autumn form, in those localities where several successive broods occur. At the same time that *keewaydin* and *eurytheme* were flying together in a perfectly fresh state in the San Bernardino Valley specimens of *ariadne* were taken in the mountains, 3000 feet higher up; but there appeared to be much less constancy among the broods in a mountainous country like California than is said to be the case in Texas and some of the South-western States. Mr. Elwes remarked that another interesting species of *Colias* was *C. harfordi*, which was only captured at the Cajon Pass, on the borders of the desert on the eastern side of the San Bernardino Mountains, though it occurs in other parts of this region. It is one of those very difficult species of *Colias* in North America, which, though affording certain characters by which an experienced eye can distinguish it from other forms, is yet so nearly allied to several that its classification is a matter of great uncertainty. As illustrative of this point Mr. Elwes showed specimens of *Colias hageni*, from Colorado, which outwardly resembles *C. philodice* very nearly, though its larva is said to be different, and which is at the same time believed to be most nearly allied to *C. chrysotheme*. Mr. Elwes alluded to the doubts which are expressed by American lepidopterists as to the identity of the *Colias chrysotheme* of Europe (a single-brooded species found most commonly in Austria and Hungary, which varies but little) with the extremely variable, wide-ranging and many-brooded *Colias chrysotheme* of North America. He stated that though male specimens could be picked out of an American series,

which could not be distinguished from European examples, yet that a number of specimens together could be certainly recognized as having come from either America or Europe.

Among the butterflies from the Yellowstone Park, the rarest and most interesting was *Erebia haydeni*, which has been recently figured in Edwards' 'Butterflies of North America,' but which, in Mr. Elwes' opinion, probably belongs to the genus *Cœnonympha*, and is most nearly allied to *C. Nolckeni* from Turkestan, whilst there is no species of *Erebia* in any part of the world to which it has any outward resemblance.

Mr. Elwes further stated that *Thecla spinetorum*, a species described from California, but hardly known in any American collections, was also found very abundant in glades in the forest in the Upper Geyser basin of the Yellowstone Park. In the same place was taken *Pieris occidentalis*, which is hardly separable from the Alpine and Himalayan *Pieris callidice;* also a form, called *oleracea*, of *Pieris napi*, which varies in such a wonderful manner in North America, and has been the subject of an excellent monograph by Mr. W. H. Edwards in "*Papilio*."

Mr. Elwes remarked that *Chionobas uhleri*, *C. chryxus*, *Erebia epipsodea*, *Argynnis eurynome*, *helena*, and *freja* were other Alpine forms taken in the National Park, the latter so nearly identical with Scandinavian specimens, that it would be hardly possible to separate them. He said that not less than forty species of butterflies were taken in the four or five days, or parts of days, on which the weather, and the wonderful scenes of interest with which the Park abounds, allowed collecting to be prosecuted; and as the season was only then beginning, he thought it probable that a diligent collector would reap a very rich harvest during the latter half of June and July. The elevation being considerable, and the climate very cold in winter and sunny in summer, whilst no cattle are allowed to graze in the Park, all the conditions for an abundant harvest of insects were present; and though the flora has much of an alpine character, yet the variety of herbaceous plants is very great.

In conclusion, Mr. Elwes said that a branch line from the Northern Pacific Railway made the Park very easy of access,

and the few days spent there would always be remembered by him as some of the most agreeable and profitable in a tour of unusual interest.

Lord Walsingham, Mr. Kirby, and Dr. Sharp took part in the discussion which ensued.

Mr. H. Goss exhibited, for Mr. W. J. Cross, an extraordinary melanic variety of a species of *Agrotis*,—believed to be either *segetum* or *corticea*,—caught by the latter near Ely in July last.

Mr. White exhibited specimens of preserved larvæ of *S. convolvuli*, *A. tau*, and other species referred to in Mr. Poulton's paper.

Papers read.

Mr. W. L. Distant read a paper entitled "An enumeration of the *Rhynchota*, received from Baron von Muller, and collected by Mr. Sayer in New Guinea, during Mr. Cuthbertson's expedition."

Mr. Poulton read a paper entitled "Notes in 1887 upon Lepidopterous Larvæ, &c., including a complete account of the life-history of the larvæ of *Sphinx convolvuli* and *Aglia tau.*"

1. *The Ontogeny of Sphinx convolvuli.*—The life-history of this larva was worked out with very great care. The egg is much smaller than that of *S. ligustri*, and the young larva is also smaller, although at some point in the ontogeny it overtakes and finally passes the size of the larva of *S. ligustri*. The caudal horn is at first bifid, the depth of the fork varying greatly. There was a most interesting transition from the green to the brown varieties of the larvæ, from which it was possible to reconstruct the phyletic steps by which the latter has arisen from the former. Red spots, homologous with those on *Smerinthus* larvæ, are certainly present, and are connected with the borders to the stripes.

2. *The Ontogeny of Aglia tau.*—The most interesting points about this history were:—The marked *Sphinx*-like appearance and attitudes of the larvæ; the fact that only four stages are present; the extraordinary change at the third ecdysis, the previous stages having been very similar; the existence of a terrifying eye-like mark in the last stage, capable of being opened and closed. The relation of these larvæ to the *Sphingidæ* is *very close*, and especially so to the genus *Smerinthus*, and the

North-American Smerinthine genus *Ceratonia*, in which the larva possesses four thoracic spines in addition to the caudal horn. The comparison leaves no doubt that the *Sphingidæ* are a specialized offshoot from the not very remote ancestors of the Saturnian Bombyces, and that they are connected with this group through *Aglia*, on the side of the *Bombyces*, and the Smerinthine genera on the side of the *Sphingidæ*.

3. *The cause and meaning of the Sphinx-like attitude.*—This attitude, which is equally marked in *Aglia*, is due to the strain caused by gravity upon the anterior unsupported part of the body, together with the compensating muscular reaction. It is most marked in the vertical position of the larva with the head upwards, and also in the horizontal position with the back downwards, and least of all the position of the Sphinx,—horizontal with the back upwards.

4. *A graphic method of representing the growth of larvæ.*—Attention was called to the fact that many important points in the ontogeny could be seen by a glance at a properly-constructed "curve" of larval growth, in all stages.

5. *The means of defence of the larva of Stauropus fagi.*—The larva, when undisturbed, is extremely well protected by resembling a withered beech-leaf; disturbed, it assumes an alarming attitude, in which it resembles a highly-idealised spider; further alarmed, it exposes two black marks on each side, which probably suggest ichneumon stings and thus warn off an insect enemy.

6. *Meaning of the black colour of the eggs of Paniscus cephalotes.* — These external eggs are of a shining black appearance, and highly conspicuous against the skin of many larvæ; they doubtless serve to warn off other ichneumons which lay similar eggs, and also those which lay internal eggs, for the black eggs resemble the scars (which always become black) made by the latter ichneumons in the act of oviposition.

7. *Defensive meaning of "tussocks" and associated black intersegmental markings.* — The "tussocks" are defensive structures; they are held very conspicuously when the larva is alarmed, and look like solid outgrowths, which would be

very feasible objects of attack; the black markings help to make them more conspicuous and to appear more projecting. When seized, large numbers of the hairs come out without injury to the larva, and with unpleasant consequences to the enemy.

8. *Protective resemblance of the larva of Geometra papilionaria.*—These larvæ, which always feed on catkin-bearing trees, resemble catkins in colour, shape and attitude. Of twelve larvæ in my possession the green ones spun first, and at the time when the catkins around were green; the brown ones lived longer until they became brown. Greater numbers would be necessary to prove that this is invariable. The dimorphism is certainly of value, for if not, one form would very soon disappear. I have found by experiment that the moths from the green form produce a vast preponderance of green larvæ in the next generation.

9. *Defensive secretion of larvæ of Crœsus varus.* — The secretion was certainly acid; but its chemical nature could not be made out.

10. *Geometriform structure and attitude of the young larvæ of Euclidia mi.*—The appearance of the larva was shown in a figure.

11. *The determination of sex in certain living lepidopterous larvæ.*—In all transparent larvæ the testes are distinctly visible as two lobate bodies side by side on the back of the fifth abdominal segment. They are generally brown or yellow in colour. They are especially distinct in the transparent larvæ of Tortrices.

November 7, 1888.

Dr. David Sharp, F.L.S., F.Z.S., President, in the chair.

Donations to the Library were announced and thanks voted to the respective donors.

Election of Fellows.

Mr. H. Stuart Fremlin, M.R.C.S., of Mereworth, Maid-

stone, and Mr. George Vernon Hudson, of Wellington, New Zealand, were elected Fellows.

Exhibitions, &c.

Mons. A. Wailly exhibited a large and interesting collection of Butterflies recently received from the Gold Coast and other parts of West Africa. The collection included specimens of the following species:—*Papilio menestheus*, *P. merope*, *P. erinus*, *P. phorcas*, *P. cynorta*, *Diadema salmacis*, *Salamis anacardii*, *S. cacta*, *Euryphene phantasia* (male and female), *Romalæosoma sarcoptera*, *R. themis*, *R. agnes*, *R. janetta*, *R. inanum*, *R. ceres* (and a variety), *R. pratinas*, *Hamanumida dædalus*, *Charaxes brutus*, *C. tiridates* (male and female), *C. berenice*, *C. lucretius*, *C. carteri*, *Harma eyesta*, *Cyllogenes chelys*, *Amauris niavius*, *Tirumala petiverana*, *Junonia clelia*, *Aterica cupavia*, *Hypanis goetzius*, *Eurytela ophione*, *Mycalesis martius*, *Cyrestis camillus*, *Nepheronia thalassina*, *Phrissura sylvia*, *Mylothris rhodope*, *Belenois calypso* (male and female and var.), and *Nychitona medusa*. In addition to the above-named there were several undescribed species which Mons. Wailly said were not represented in the British Museum Collections.

Mr. Jenner Weir exhibited four bred specimens of Ant-lions, two of which were from Saxon Switzerland, and the other two from Fontainebleau. He stated that he believed the specimens belonged to two distinct species. Mr. M'Lachlan said that the specimens all belonged to one species, viz. *Myrmeleon formicarius*, Auct. = *europæus*, M'Lach.

Mr. W. C. Boyd exhibited an example of *Pterophorus zetterstedtii*, taken at Sydenham. He remarked that this species had hitherto only been recorded from Lynmouth and Folkestone.

Mr. Enock exhibited specimens of *Cecidomyia destructor* (Hessian Fly), illustrating the life-history of the species, and made remarks on them.

Mr. Wallace Kew exhibited a specimen of *Dytiscus marginalis* having a small bivalve shell attached to one of its legs. The bivalve had apparently attacked the *Dytiscus* and refused to relax its grasp. A discussion ensued, in which Dr. Sharp, Mr. Stainton, and Mr. Kew took part.

Mr. W. E. Nicholson exhibited several specimens of *Acidalia immorata*, Linn., caught by him near Lewes. Mr. Jenner Weir remarked that the species had only recently been added to the British list, and that it was remarkable how so comparatively large a species could have been hitherto overlooked. It was also remarked that a specimen of this species from the collection of the late Mr. Desvignes had been exhibited by Mr. Stevens at the meeting of the Society in November, 1887.

Dr. Sharp exhibited a large number of species of Rhynchophora, collected by Mr. George Lewis in Japan.

Papers read.

Mr. F. P. Pascoe read a paper entitled "Descriptions of new Longicorn Coleoptera."

Dr. Sharp read a paper entitled "The Rhynchophorous Coleoptera of Japan." The author said that the *Rhynchophora* brought by Mr. George Lewis from Japan, fifteen years ago, were examined by M. Roelofs, and described by him in some papers that appeared in the 'Annales de la Société Entomologique de Belgique,' 1874 and 1880. Since then Mr. Lewis had obtained a much more extensive collection, and as M. Roelofs was no longer occupied with entomology, he had undertaken the task of revising the collection by the assistance of this much richer material; and he now dealt with the first two families, *Attelabidæ* and *Rhynchitidæ*. Dr. Sharp remarked that he was surprised to find, on examining the first of these groups that they formed an exception to the other *Rhynchophora* in the structure of the prosternum. Leconte recently drew attention to the importance of this part of the body as a means of separating the *Rhynchophora* from other Coleoptera; and it was very curious that he should not have noticed that this family, which he correctly placed at the commencement of the series, differed from his definition of *Rhynchophora* in this important particular. In order to define the structure of the prosternum in these insects, Dr. Sharp said he had been obliged to make use of. a new term, which he would explain.

December 5, 1888.

Dr. David Sharp, F.L.S., F.Z.S., President, in the chair.

Donations to the Library were announced and thanks voted to the respective donors.

Election of a Fellow.

Mr. B. A. Bower, of Eltham, Kent, was elected a Fellow of the Society.

Exhibitions, &c.

Mr. W. F. Kirby exhibited, for the Rev. Dr. Walker, a variety of the female of *Ornithoptera Brookiana;* he also exhibited, for Major Partridge, an undetermined species of the genus *Hadena*, captured last summer in the Isle of Portland.

Mr. R. South exhibited a series of specimens of *Tortrix piceana*, L., from a pine-wood in Surrey; also—for comparison—melanic forms of *Tortrix podana*, S.

Prof. Meldola exhibited, for Dr. Laver, a melanic specimen of *Catocala nupta*, taken last September at Colchester.

Mr. E. B. Poulton exhibited preserved larvæ of *Sphinx convolvuli*, showing the extreme dark and light forms of the species. The specimens had been prepared by Lord Walsingham and presented to the British Museum.

Mr. M'Lachlan called attention to a plate, representing species of the genus *Agrotis*, executed by photography, illustrating a memoir by Dr. Max Standfuss, in the Correspondenz-Blatt, Verein 'Iris,' in Dresden, 1888. He considered it was the best example of photography as adapted for entomological purposes he had ever seen, especially as regarded its stereoscopic effect.

The Rev. Canon Fowler exhibited a specimen of *Mycterus curculionoides*, L., sent to him by Mr. Olliff, and taken by Mr. Gunning near Oxford about 1882.

Mr. W. E. Nicholson exhibited several melanic varieties of *Argynnis niobe* and *A. pales*, collected by himself last summer in the Engadine.

Mr. J. H. Leech exhibited a collection of Lepidoptera formed last year by Mr. Pratt at Kiukiang, Central China. It in-

cluded several new species, also specimens of a variety of *Papilio sarpedon* and other interesting forms.

Mr. H. Goss exhibited, for the Rev. T. A. Marshall, fifteen undescribed species of British *Braconidæ*.

Mons. A. Wailly exhibited a collection of Lepidoptera lately received from Assam, containing upwards of thirty-five species of *Papilio*, *Ornithoptera*, *Charaxes*, *Diadema*, *Cyrestis*, and other genera.

Mr. Meyer-Darcis exhibited specimens of *Sternocera tricolor*, Kerr, and *S. variabilis*, Kerr, from Lake Tanganyika; also two new species of *Julodis* from Syria.

Mr. F. Merrifield exhibited, and made remarks on, a long series of *Selenia illustraria*, *S. illunaria*, and *E. alniaria*, in illustration of his paper on "Pedigree Moth-breeding."

Lord Walsingham exhibited, and made remarks on the following species belonging to the genera *Snellenia*, Wlsm., *Œdematopoda*, Z., and *Eretmocera*, Z.:— *Snellenia coccinea*, Wlsm., sp. n., *S. lineata*, Wlk., *S. latipes*, Wlk., *S. bimaculata*, Wlsm., sp. n., *Œdematopoda princeps*, Z., *Œ. clerodendronella*, Stn., *Œ. ignipicta*, Btl., *Œ. leechii*, Wlsm., sp. n., *Eretmocera fuscipennis*, Z., *E. carteri*, Wlsm. sp. n., *E. derogatella*, Wlk., *E. dorsistrigata*, Wlsm., sp. n., *E. miniata*, Wlsm. sp. n., *E. scatospila*, Z., *E. basistrigata*, Wlsm., sp. n., *E. extissima*, Z., *E. impactella*, Wlk., *E. chrysias*, Meyr., and *E. medinella*, Stgr. These species were from New South Wales, Brazil, Borneo, Natal, India, Japan, Zanzibar, Ceylon, Spain, &c.

Papers read.

The Rev. T. A. Marshall communicated a paper entitled "A Monograph of British *Braconidæ*. Part III."

The Rev. Dr. Walker communicated a paper entitled "A Description of a variety of *Ornithoptera brookiana* (female)."

Lord Walsingham read a paper entitled "A Monograph of the genera connecting *Tinægeria*, Wlk., with *Eretmocera*, Z." Mr. Stainton observed that the insects to which Lord Walsingham's paper referred were extremely interesting in many respects. From their gay colouring he was of opinion that all would be found to fly in bright sunshine. It was unfortunate

that at present only the larva of a single species (*Clerodendronella*), was known; but Lord Walsingham had well shown that the botanical genus *Clerodendron* occurred in all the parts of the globe, whence specimens of these insects had been received, and now that the attention of collectors had been called to this fact, there was a better prospect of our learning the early stages of other species. Mr. Stainton also observed that as the genus *Butalis* had been alluded to more than once in the remarks of Lord Walsingham, he ought perhaps to mention, that he had never been able to persuade himself that it was rightly placed amongst the *Elachistidæ;* in his idea, the more robust habit of the imago, and the general appearance and habit of the larva, ill accorded with such a location.

Mr. F. Merrifield read a paper entitled "Incidental Observations on Pedigree Moth-breeding." He said the forced *Selenia illunaria* of the fifth generation of 1887, exhibited as larvæ at the meeting in December, 1887, had come to an end. Thirty moths appeared between Dec. 26th and Jan. 28th, showing signs of deterioration. From one pair of these he had 179 eggs, which turned red and were exposed to winter cold until 14th April, when they were forced. On the 17th they changed colour, showing the young larvæ through the shells, but never actually hatched. This would seem to indicate that this insect, which now hybernates as a pupa, might possibly under changes of climate hybernate as an egg. As to the larger size of the male *S. illunaria* in the spring emergence, suggested last year, subsequent measurements on a large scale confirmed it; the excess was small, but it compared with a large excess in the opposite direction in the summer emergence. He had tried experiments with reference to the effect of high and low temperature on the larva, as well as on the pupa. It appeared that the temperature most conducive to development of size of the larva in *S. illunaria* and *illustraria* was one rather higher than that of a warm English summer. All his unforced broods of both species in the very cold summer of 1888 were decidedly smaller than the corresponding ones of last year, and the proportion of healthy insects pupating and emerging was considerably less. This could not be ascribed to interbreeding,

&c., because it also extended to larvæ of a moth caught in the woods. He exhibited specimens of *illustraria* illustrative of the extremes in size and colour yet attained by him; there were forms, in both sexes, of a chestnut colour with few markings on the upper surface and of a bright orange beneath. This showed an advance in colouring, but not a very great one, on the original stock bred from, which showed considerable variations both in colour and in intensity of marking. The experiments next described were as to the effect of cold on the pupa. Out of 174 pupæ, offspring of a single pair, 39 were subjected, for a fortnight in July, to a steady temperature of 33°–34° Fahr. The moths of which the pupæ were so treated showed a noticeable but not great darkening of hue, and, in the females especially, there was a tendency to the contrast between the dark inner portion and the light outer portion of the wings, which is so marked a feature in the spring emergence. Some pupæ which had been kept at a forcing temperature in the autumn of 1887, produced moths considerably lighter in their colour than some of the same batch which were exposed to the open air from Nov. 7th to Jan. 1st. Out of another batch of some 50 or 60 pupæ obtained by Mr. Jenner from eggs laid in the spring, two of which emerged as moths in July, the rest showing no signs of emerging, some were lent by Mr. Jenner for experiment, and were forced from Sept. 10th; eight or nine came out at various intervals from Sept. 27th to Oct. 19th; these were intermediate between the spring and summer colouring, and showed an almost regular darkening in colour according to lateness in emerging. Mr. Merrifield said that so far the results of experiment were quite in accordance with those of Prof. Weissman and others, but other experiments seemed to show that the temperature to which the larva in its growing stages was exposed had much to do with the colour of the perfect insect. Forty eggs of *E. alniaria* (now *autumnaria*) were forced, and forty eggs from the same source were sleeved. From the former 29 moths appeared, in an average period of about 46 days; from the latter 25 were reared, in an average period of over 90 days, these last having been brought indoors before several of the later ones pupated, and

all the pupæ being brought indoors for all or the greater part of their existence as such. The forced ones, which he exhibited, were strikingly different in appearance from the others, being of a warmer, yellower tint and much less spotted and marked with dark. His experiments were by no means completed; so far as they had gone, they seemed to show that retardation in the earlier stages was a cause of darkness of hue in the perfect insect, a retardation that would be the result of cold; and perhaps this threw light on the tendency to melanism often noticed in North-country examples of generally-distributed moths. The experiments with *alniaria* seemed very strongly to indicate, that the temperature to which the growing larva is exposed influences the colouring of the moth either directly or, more probably, by producing retardation, since the temperature was not a very low one, and the gradual darkening of the colour in the *illustraria* moths emerging from the pupæ lent by Mr. Jenner, and all kept at a summer or forcing temperature, seemed some evidence that retardation without cooling will originate the dark hue. Mr. Merrifield said he had not had facilities for bringing up so many separate broods as he should have liked to do, and that he would gladly hand over eggs from varieties, to those likely to follow out the results of breeding in any particular lines; and he would also be glad to be himself supplied with living specimens (for breeding) of *illustraria* from any other parts than the east and south of the United Kingdom, from which his original stock had come.

Lord Walsingham said he had observed the readiness with which a dark-coloured insect responded to a transient gleam of sunshine; and it was probably an advantage to a moth in a cold country to be of a colour which readily absorbed heat; and it would be interesting if it were established that the same cause, a cold climate, which made darkness of hue a valuable quality, was also a means of causing it.

Mr. Poulton said he had noticed in some experiments which he had conducted some years since upon *Selenia illunaria*, the same tendency of a brood of larvæ to divide into various detachments feeding up at different rates. Although his experiments were on a much smaller scale

than those conducted by Mr. Merrifield, they had yielded results which were in every way confirmatory of those described by the latter observer. Concerning the variation in the period of larval life Mr. Poulton thought it probable that, just as dimorphism or polymorphism in colour and appearance was beneficial to the species by giving it an extra chance against its enemies, so dimorphism or polymorphism in the duration of life was advantageous in giving the species an extra chance of a favourable season as regards climate or prevalence of enemies. Mr. Poulton could quite endorse Mr. Merrifield's observation that when an individual possessed the tendency towards a rapid or a protracted development, it had a great power of resisting those conditions of temperature which tended to modify the rate of its development. This observation pointed towards the conclusion that the variation was innate in the individual, and was doubtless predetermined in the egg from which it developed, and was not produced by any of the surroundings in the larval or other states. Mr. Poulton congratulated the author upon his results, and trusted that the experiments would be continued.

Prof. Meldola said that this was the first successful experiment in the way of modifying the seasonal forms of a British seasonal dimorphic species that had been carried out in this country. Such results he had long been waiting for, and he congratulated Mr. Merrifield upon the thoroughly painstaking manner in which he was carrying on the investigation. Referring to Prof. Weismann's theory of seasonal dimorphism Prof. Meldola said that the dark form must, in accordance with this view, be regarded as the ancestral form retained from the Glacial Period, and that artificial refrigeration had a tendency to cause reversion to this darker type. The reason why the Glacial form was the more darkly coloured was a question quite distinct from the present line of inquiry, but he could not help repeating the opinion which he had already expressed elsewhere, that the darker coloration had been acquired (through natural selection) because of the advantage conferred upon the species in enabling the individuals to make the most of the sun's radiant energy, at a time when the atmosphere was probably highly charged with

water in different states of condensation. This was substantially the theory first put forward by Lord Walsingham, and he (Prof. Meldola) had already expressed his concurrence therewith.

Mr. White asked whether Mr. Merrifield had observed that a variation in the colour of the moth was associated with any corresponding variation in the colour of the larva.

Mr. Merrifield said the larva of *illustraria* varied much in colour. The summer-feeding larva was brighter and had more variety in colour than the autumn-feeding brood, which are of a more uniform and duller tint, a shining grey-brown, looking very like a knotty ash-twig. He had not observed any connexion between the colour of the larva and that of the moth.

Dr. Sharp said he thought the experiments described were very interesting, and he hoped they would be continued and followed up by others in different directions.

Mr. J. H. Leech read a paper "On a Collection of Lepidoptera from Kiukiang." He said the collection had been made for him during the months of April, May, June and July, 1887, by Mr. A. E. Pratt, in the neighbourhood of Kiukiang, which was situated on the Yangzee river, about 500 miles from the sea. Mr. Leech remarked that the collection was not rich in species, and probably only represented a third part of the lepidopterous fauna of the district; it, however, contained a fair proportion of new species, and also many that had not hitherto been recorded from that region. It was stated that the larger proportion of species were common to the eastern coast of China and Japan, but that many occurred also in the Himalayas. The chief point of interest in the collection was the variation exhibited in so many species, especially in *Papilio sarpedon.*

Mr. Elwes said he had examined the collection with great interest, and was much struck with the similarity of many of the forms to those from Sikkim.

ANNUAL MEETING.

January 16th, 1889.

Dr. David Sharp, F.L.S., F.Z.S., President, in the chair.

An abstract of the Treasurer's accounts was read by Mr. Osbert Salvin, F.R.S., one of the Auditors.

Mr. H. Goss, one of the Secretaries, read the following:—

Report of the Council.

In accordance with the Bye-Laws, the Council beg to present the following Report:—

During the year 1888 five Fellows have died, *viz.*, the Rev. J. H. Brown, M.A.; Mr. Philip Henry Gosse, F.R.S.; Mr. R. M. Lingwood, M.A.; Mr. H. J. S. Pryer; and Mr. George R. Waterhouse. Four Fellows have resigned; and seventeen new Fellows have been elected.

The number of Fellows elected during the year, although small in comparison with the number elected in 1886, is equal to, if not above, the average. At the same time the Society is in need of a larger number of members to enable it to publish more papers, and in other ways to advance its interests and promote its objects; and the Council earnestly hope that the Fellows will do their utmost to induce their friends to join the Society.

At the present time the Society consists of an Hon. Life-President, 10 Honorary Fellows, 46 Life Fellows, and 247 paying the Annual Subscription, making the total number of Fellows now on the Society's List 304, which, after allowing for the losses by deaths and resignations, is an increase in number of 8 since the date of the Annual Meeting last year.

The Transactions for the year 1888 form a volume of 606 pages, containing 15 memoirs contributed by the following 14 authors, *viz.*, Professor Westwood, M.A. (2 papers); Mr. James Edwards; Mr. Arthur G. Butler; Mr. Geo. T. Baker; Mr. Frederic Merrifield; Mr. G. F. Mathew, R.N.; Mr. Martin Jacoby; Mr. C. O. Waterhouse; Mr. Edward Meyrick, B.A.; Mr. William White; Mr. H. J. Elwes;

Mr. W. L. Distant; Mr. F. P. Pascoe; and Mr. E. B. Poulton, M.A. Of these 15 papers 9 relate to Lepidoptera (or to enquiries in which Lepidoptera were the subjects of experiment), 3 to Coleoptera, 2 to Hemiptera, and 1 to Neuroptera.

The memoirs above referred to are illustrated with 17 plates, of which 11 are coloured. The Society is indebted to Mr. Elwes for contributing £25 towards the cost of Plates VIII., IX., X. and XI.; to Mr. Pascoe for Plate XIV.; and to Mr. Poulton for Plates XV., XVI. and XVII.

The Proceedings, containing an account of the exhibitions and discussions at the Meetings in addition to abstracts of several of the papers published in the Transactions, and also one or two papers not published in the Transactions, extend to over 68 pages.

The publication of a Catalogue of the Books and Pamphlets in the Society's Library has long been under consideration, and on the 6th day of June last a Library Catalogue Publication Committee was nominated by the Council, consisting of Dr. Sharp, Mr. Stainton, Mr. Salvin, Mr. M'Lachlan, Mr. Grut, and Mr. J. W. Dunning.

The Report of this Committee, in which the publication of the Library Catalogue was recommended, was submitted to the Council on the 5th day of December last, and the estimated expense being not too heavy, and the Honorary Librarian having kindly consented to undertake the preparation of the manuscript, the Council have decided to print the Catalogue. In view of the expense of printing the Catalogue three Compositions, in lieu of Annual Subscriptions, received during the year were retained by the Treasurer, instead of being invested in the usual way. Some portion of the amount of these compositions has been expended, but the remainder is in hand. Consequently the Treasurer's balance is above the average; but, as a result of the non-investment of the compositions, the Society's capital has not increased since the date of the last Annual Meeting.

During the past year about one hundred Books, Pamphlets, Journals and Papers have been added to the Library; the Meetings have been better attended than in any previous

year of the Society's existence; there has been a steady increase in the number of Fellows; and the financial position of the Society compares favourably with that of past years, the year 1886 being of course excepted.

On the whole, therefore, the Council have reason to be satisfied with the progress made by the Society during the year 1888.

The following is an Abstract of the Receipts and Payments during 1888:—

Receipts.	£	s.	d.	Payments.	£	s.	d.
Balance in hand 1st Jan., 1888	8	14	7	Rent, Office Expenses and Salary to Assistant-Librarian	134	6	5
Contributions of Fellows	322	7	0	Printing	193	4	1
Sale of Publications	101	12	5	Plates, &c.	94	13	1
Donations	15	12	6	Books, Binding, &c.	13	18	6
Interest on Consols	15	8	2	Balance in hand	27	12	7
	£463	14	8		£463	14	8

11, Chandos Street, Cavendish Square, W.,
January 16th, 1889.

The Secretaries not having received any notice proposing to substitute other names than those in the lists prepared by the Council, the following Fellows constitute the Council for 1889:—Henry W. Bates, F.R.S.; Henry J. Elwes, F.L.S.; William H. B. Fletcher, M.A.; the Rev. Canon Fowler, M.A., F.L.S.; Frederick DuCane Godman, M.A., F.R.S.; Herbert Goss, F.L.S.; Ferdinand Grut, F.L.S.; P. Brooke Mason, M.R.C.S., F.L.S.; Prof. Raphael Meldola, F.R.S.; Osbert Salvin, M.A., F.R.S.; Edward Saunders, F.L.S.; Dr. David Sharp, F.L.S.; and the Right Hon. Lord Walsingham, M.A., F.R.S.

The following are the officers elected:—*President*, the Right Hon. Lord Walsingham; *Treasurer*, Mr. Edward Saunders; *Secretaries*, Mr. Herbert Goss and the Rev. Canon Fowler; *Librarian*, Mr. Ferdinand Grut.

The President then delivered an Address, at the conclusion

of which Mr. Elwes proposed a vote of thanks to Dr. Sharp for his services as President during the year. The proposal was seconded by Mr. Salvin, and carried.

A vote of thanks to the Treasurer, Secretaries, and Librarian was moved by Mr. Dunning, seconded by Lord Walsingham, and carried.

Mr. Saunders, Mr. Goss, and Mr. Grut severally replied.

Abstract of Receipts and Payments for 1888.

Receipts.		£	s.	d.
Balance 1st Jan., 1888		8	14	7
Subscriptions	,,	235	4	0
Entrance Fees	,,	29	8	0
Arrears	,,	10	10	0
Compositions	,,	47	5	0
Donations	,,	15	12	6
Sale of Transactions		101	12	5
Interest on Consols	-	15	8	2
		£463	14	8

Payments.	£	s.	d.
Rent, Salary to Assistant-Librarian, & Office Expenses	134	6	5
Printing - - -	193	4	1
Plates, Colouring, &c. -	94	13	1
Books, Binding, &c. -	13	18	6
Balance in hand	27	12	7
	£463	14	8

ASSETS.

		£	s.	d.
Subscriptions, considered good		10	10	0
Consols, £395 9*s.* 4*d.*	(cost)	377	4	0

LIABILITIES.

(Nil.)

Audited and found correct, January 9th, 1889.

H. T. Stainton.
A. Eland Shaw.
J. W. Dunning.
R. McLachlan.
Osbert Salvin.

THE PRESIDENT'S ADDRESS.

GENTLEMEN,

IT is agreeable to learn, from the reports of the Council and Auditors, that our Society is in a satisfactory condition as compared with previous years. If indeed we extend our view to a longer period than that of a single year, I think it is clear that we have much reason for congratulation. Twenty years ago the Entomological Society consisted of only 200 members, now it has just over 300, an increase of 50 per cent., and the larger part of this increase has been in the later years of the period. In 1868 we had only £100 of investments, and now we have nearly £400. Thus we have undoubtedly made a steady though slow progress in material prosperity. In regard to scientific activity I do not think there is much change: the range of subjects discussed at our meetings, and recorded in our annual volume, is about the same as it was at the commencement of the period, and the volumes are on the whole similar in size or quantity to what they were in 1868; but it should not be forgotten that in that year a new era in the Society's existence was inaugurated under the skilful management, and aided by the generous liberality of our then Secretary, Mr. Dunning. Previous to the year 1868 we did not publish any annual volume, but only such parts as the Council from time to time felt themselves able to do; and in the period of thirty-two years from 1836 to 1867 the Society published only fifteen volumes in all; we have in the subsequent twenty years published twenty volumes, so that the change instituted by Mr. Dunning has resulted in just about doubling the amount of matter annually published by the Society. Moreover, every Fellow who pays his subscription now receives the volume we publish,

whereas formerly, most of the members who wished for it had to pay an additional sum for its possession. As the annual volume is now well worth the small subscription we exact from our Fellows, there is good reason for expecting that as the existence and advantages of the Society become more widely known, the number of our Fellows may continue to increase.

We have lost by death during the year five Fellows. One of them, George Robert Waterhouse, who died at an advanced age, was mongst the most distinguished of the entomologists of this country; he was one of the founders of our Society, and was formerly one of its Presidents; his name is of prominent importance in Zoology, and he rendered great services to our own division of that branch of science; a brief memoir of his life has been drawn up by one of his sons, and will be published in our annual volume. Philip Henry Gosse had been one of our Fellows since 1879; he also died at a very advanced age; he resided in Devonshire and I believe did not appear at our meetings, but he was well known to naturalists in connection with the natural history of Jamaica; he published a very pleasing book, that contains much information on entomological subjects, descriptive of his residence there; and his paper on the clasping organs of some Lepidoptera, published in the Transactions of the Linnæan Society, attracted much attention amongst lepidopterists. Mr. H. J. S. Pryer had belonged to the Society since 1867; he died in the prime of life, in Japan, where he had been resident for fifteen or sixteen years. During this period he devoted much attention to Entomology, more particularly to Lepidoptera, and published lists of the species found there. He was actively engaged in working at the Japanese Lepidoptera at the time of his unexpected and regretted decease. The Rev. Henry Thomas Browne, of High Wycombe, had belonged to the Society for twenty-six years; and Robert Maulkin Lingwood, of Cheltenham, was a member for no less than fifty-three years. I regret that I had not the pleasure of the acquaintance of either of these gentlemen, and can give you no information about them. I am not aware that either of them published anything on entomological subjects.

John Scott, who died in 1888, had an extensive knowledge

of the order Hemiptera, and was Mr. Douglas's co-labourer in the production of the volume published by the Ray Society, descriptive of our native species of the insects of that order.

I have heard in 1888 of few deaths of entomologists in foreign countries; the only prominent names that I recall are Bellier de la Chavignerie of Evreux, and Donckier de Donceel, senior, of Liège.

Among the subjects that have attracted the attention of entomologists in recent years, the senses and instincts of insects are prominent, and I have myself been much interested, as an attentive reader, of what has been written about them. Sir John Lubbock has just published a book dealing with the subject, with which you all are probably acquainted, and with which, like myself, you probably have been much pleased. I had decided on addressing you on the subject before the appearance of our esteemed ex-President's interesting work, and have decided not to abandon my intention because of its publication: for though I discuss the same topics, and entertain on the whole similar views, yet the subject is so extensive that I hope my address will be found not to be a mere repetition of what is said in "The Senses and Instinct of Animals." The object of my brief review will be to recall to you that we have little positive knowledge of the functions of the sense-organs of insects, and that some of the views that have been expressed in a very positive manner, to the effect that insect instincts are inexplicable on the theory of their gradual evolution, are certainly premature and probably erroneous.

The most important of the senses of insects is that of vision. The higher insects are remarkable for their activity, and for the facility and perfection of their movements; and there is little doubt that the perceptions of their optical organs are their chief guides in the execution of their remarkable evolutions; these organs, as you all know, are of two kinds, compound eyes and ocelli.

It would occupy us too long if I were to sketch the various views that have been expressed as to the function of sight, and more especially of the compound eyes in insects; but there is a brief and very fair summary of the subject, extending to the year 1875 or thereabouts, in Grenacher's

'Untersuchungen über das Sehorgan der Arthropoden,' from which it will be gathered that Müller's theory of mosaic vision is the one that has proved most generally acceptable. The earlier entomologists appear to have been contented with the simple statement that insects possess the sense of sight, or that they see; but Johannes Muller, about sixty years ago, propounded a theory as to the nature of their vision, and this has been known since as the mosaic theory. It may be briefly described by saying that he thought an insect saw by means of a picture, as our own eyes do; and that the picture in the insect eye was composed of a large number of separate pieces, each facet contributing a small piece.

This is evidently the simplest view that can be at all maintained, and we may take it for granted that it was pretty sure to be the one that would first occur. There is no way of explaining insect-vision so easy as that of saying it is like our own, and then adding that it is broken up somewhat because of the numerous facets of the insect-eye; and it is probably owing to this primitive simplicity that the mosaic theory has had so long a career; for though it has been frequently opposed and even altogether buried, it has always recurred again when rival theories proved unsatisfactory; and I am of opinion that the vitality of the theory is chiefly due to its ease of comprehension by making the vision of the insect-eye so very similar to that of our own eye. But . . .

I believe that my much-gifted and ever-to-be-remembered friend, the late W. K. Clifford, once stated that the human or vertebrate eye is a very imperfect optical apparatus; and he was undoubtedly correct in this, as he also was in explaining that the defects of the apparatus itself are in part removed, and its deficiencies in part supplemented, by secondary means. The vision of the human eye is by picture cast on the retina, which is practically a highly sensitive recipient screen, placed at the back of a camera obscura; but the picture so limned is, as a representation of external nature, very imperfect: for instance, everything is flat, and it is indistinct except in its centre. Now if picture-vision is to be of much use to the insect it should have the secondary means of making it useful. What are they?

Amongst the most important is undoubtedly individual experience. In the early period of life of which we have no memory, the mind is learning to supplement some of the deficiencies of the eyes by associating with their impressions the impressions derived from other senses, notably that of touch: objects are touched and it is found that they are not flat, and it is also found that certain distinctions of light and shade go with the not-flatness, and so there gets to be established a mental association between certain delicacies of light and shade and not-flatness, and when this is thoroughly established we, being unaware of the association, and perceiving the shade delicacies by the eye, infer that the eye itself sees the non-flatness. That this is the case is proved by well-known facts, which it is unnecessary to trouble you with, as they are to be found in many physiological text-books. Individual experience and the association of tactile impressions with the ocular impressions are amongst the important means by which the defects of picture-vision are remedied. Another indispensable aid to our sight is the mobility of the eyes: this is wonderfully perfect, and as the eyes are spherical in form and the muscles are attached at several points, a very beautiful capacity of moving the eye is the result; and the extreme and perfect mobility of our eye is one of the chief factors in its utility.

Another very important feature in our vision is that we have two eyes and combine them on one object: the result is that we see single though our eyes really see double, the two pictures being slightly different; and by the unconscious inferences made from the slight differences between the two pictures we obtain some valuable properties of material objects which we think the eye directly perceives. The very important property of estimation of size of an object is also in us a mental and not an ocular power, the size of an object as pictured on the retina bearing but little proportion to its real magnitude. There are also other deficiencies in the nature of picture-vision to which I need not allude. But I will ask you to bear in mind the fact that the insect is destitute of the all-important secondary means I have alluded to, for rendering picture-vision adequate. Its life is but

short, and is in most insects cut up into stages, the experience gained in one of which would be of little use in a following stage, where the creature is provided with a different set of structures; and in point of fact we see, from observation, that the butterfly, directly after it has come into possession of its beautiful compound-eyes, knows well some of those properties of space and matter that we learn only from experience. So, again, with size; we may be sure that the insect does not infer this by a mental process: and it cannot associate tactile experiences with its ocular impressions, as we do, for not only must any tactile powers it may possess by inheriting its ancestors' associations be of a very specialised and limited nature owing to its hard external covering, but its life is too limited to allow it to acquire such associations individually. Its eyes, too, are fixed and immovable, directed mainly one to one side and one to the other, so that it receives two very distinct sets of impressions from the two eyes.

Under these circumstances it is clear that flat-picture vision is not a satisfactory function to assign to the compound eye of the insect. And even from this there is a most important deduction to be made. As yet we have not considered the mosaic part of the question. The picture formed on our retina, if defective in various other ways, is, at any rate, continuous; but in the insect, on the Mullerian theory, it is certainly broken up, and must be on this account less valuable. The perfection of a mosaic picture depends largely on the amount of cement there is in it in proportion to the marble, and where the seams of cement are coarse, the perfection of the picture is greatly marred. The supporters of the mosaic theory state that the perfection of the mosaic picture in the insect's eye depends on the number and the size (or coarseness, as entomologists say), of the facets; these vary excessively, and probably would be found in many insects to greatly reduce, if not altogether destroy, the value of the picture, which would indeed at best be, not a picture, but pieces of a picture separated by intervals of blindness. I am not aware whether any attempt has been made to calculate what proportion the cement would bear to the

marble in the picture formed in the insect's eye; if so, I have not met with it: indeed, I may say, in passing, that Grenacher devotes the larger part of his chapter on the function of vision to demolishing the theories of others,—that is to say, showing how insects do not see,—and when he comes to the positive aspect, confines himself to some vague generalities; but, though it may be the case that the lines of separation in the mosaic would be very fine, yet they would be very numerous, and I wish to urge that their existence, taken in conjunction with the immobility of the insect's eye, appears to me absolutely to destroy what little value the flat-picture without secondary adjuncts might otherwise possess. In point of fact, in order to see anything, the insect must come to a dead standstill, for to a moving insect with a fixed eye the lines of interruption of the mosaic would appear to move, and cause the flat-picture to become a complete blur. I attach considerable importance to this consideration, because we know that the compound eye attains its highest perfection in insects with great powers of flight,—in other words, that the compound eye is a guide during rapid motion. Now let me ask you to recall that when we ourselves are in movement it is a great obstacle to the satisfactory exercise of our function of picture-seeing; indeed, when we are in rapid motion, we can only see at all by keeping up a constant movement of the eye, so as to counteract the motion of our body, and this causes such fatigue that the effort to look at near objects, amongst which we are moving, cannot be for long carried on. How, then, can an insect in motion, with two separate and different flat pictures in its fixed eyes, each picture blurred by the passage across it of the lines of cement in the mosaic, guide itself with the absolute perfection it actually exhibits? Taking all the above points into consideration, I think mosaic vision for insects must be relegated to that domain where first attempts towards elucidating very difficult subjects generally go. And I think we may go farther than this and view any theory of flat-picture vision for insects with very great suspicion.

This conclusion almost renders it unnecessary to discuss in detail some of the other theories that have been put

forward, and more or less abandoned; but I must rapidly say a few inadequate words about one or two of them.

Gottsche stated that an insect's eye does not make a mosaic picture, but that it actually makes a large number of pictures of the same object, or, as Graber puts it, that when an insect looks out of its eye at a man (or something that to it is of equivalent value), it sees not a man, but a whole army of men. This does not appear encouraging, and still less does it do so when it is further suggested that the men composing this Falstaffian* army would appear to be standing on their heads. But recollect that our retinæ see two men instead of one, and yet we only see one man,—nay, that we see that one man more correctly than we should do if the retinæ only saw one man; the duplicity of the two figures is, in fact, one mode by which we see correctly: the difference between the two pictures being of great value. Is it not, then, within the bounds of possibility that if two pictures can be made to give a better result than one, one hundred pictures (or something-elses) may be made to give a better result than two? I do not think the theory of compound vision should be altogether lost sight of.

Of late years Exner has made what I consider to be some very valuable suggestions as to insect-vision; he thinks it probable that the insect-eye is specially adapted for the perception of movement, that in this capacity it is superior to the vertebrate eye, but inferior to it in definition of objects and in capacity for distinguishing the environment generally: he still, however, maintains the mosaic theory with certain modifications. Exner's views, as I have said above, I consider very valuable, and I think it probable that further investigations on his lines may have important results, especially if the idea of picture-seeing be abandoned more completely than it has been by him. He and Grenacher refer to a paper by Schmidt which I have not had an opportunity of consulting, but it appears that it also expresses dissent from the camera obscura theory.

Notthaft, too, has published some suggestions that I think certainly of value; he considers the sight of the insect

* Referring to the multiplied men in Kendal-green, not the ragged array.

compound-eye must be very different from that of the vertebrate eye; that it is inferior in perception of plane surfaces, but superior in distinguishing objects in the third dimension of space, that is, depth.

Patten is the last, but by no means the least, of the investigators of the insect-eye: his papers are chiefly anatomical, and are more especially directed to questions connected with the development and common origin of different invertebrate eyes; but he has a chapter on the function of the compound-eye of the insect, chiefly remarkable from its going a long way towards recognising the extreme difficulty of settling this: his special contribution to the anatomy of the organ I shall briefly mention further on.

Here I will take the opportunity of mentioning that there is on record a very curious observation relating to the vision of insects, though it has apparently escaped the attention of recent writers. It is an article by Mr. Spence,—in fact, the very first memoir published by our Society,—and forms Article I. of the first volume of the first series of our 'Transactions.'

Lubbock, whose opinion is of great value, because of his skill and experience as an observer of the habits of insects, says, in his recently-published book, "We know as yet very little with reference to the actual power of vision possessed by insects."

From the above I think we may fairly conclude that it is quite uncertain what insects do see, or whether they see at all, if we use the word seeing in association with the idea of our own plane-picture seeing.

Here, so far as my chief object to-night is concerned, I might leave the question, for I hope I have made it clear that we are quite ignorant on the subject of the sight of insects—the most important of their senses—and have, in fact, no knowledge whatever such as we ought to possess previously to coming to any general conclusions of importance about their habits, so far as these are affected by sight. I think it probable that the sense of sight in insects is, in so far as the eye is concerned, a more complex matter than it is in the Vertebrata: such ocular perceptions as are requisite for the orientation of the creature must be sought in the

insect in direct connection with the eye, it being impossible that it can learn by individual experience, and in the highest degree improbable that deficiencies in the optical instrument can, in the insect, be remedied by mental operations as they are in ourselves, and, if so, it becomes necessary to inquire whether the insect may not be able, by means of its eyes, to directly perceive certain important conditions of material objects that we only obtain a knowledge of by the aid of our mind. Or, to put it more correctly—as I believe—*certain cerebral structures in connection with the Vertebrate sense of sight being not present in insects, other structures to compensate for their absence may be expected to occur in more direct connection with the eye.* If so, it becomes highly probable that the functions of the insect-eyes are not only dissimilar from ours, but are also more complex. If an insect is aware of the presence of objects when it is at rest, if it is able to guide itself during rapid movement by discriminating with delicacy rapidly occurring differences of lights and shades, to perceive the direction and rapidity of movement, and to distinguish so much of the outline of objects as to give it an idea of extension in the three dimensions of space; if it has all these capacities, and perhaps others in addition, and if these are due to the eyes and not to the mind, then it certainly is highly probable that the direct functions of the optic organs may be not simple but complex; that whereas our vision is a very perfect development of one process, insect vision may be developments of two or three processes of perhaps different degrees of perfection? If this be the case, we have scarcely commenced to get any exact knowledge of the ways in which the world appears to insects. As an eye in its primitive form is an organ sensitive to light and shade, it is probable that perceptions of light and shade have become perfected in the insect's eye; and, though these may not be integrated into any continuous picture, they may be excessively perfect, and it is not improbable that insects are largely guided in their movements by direct perceptions of lights and shades. There seems considerable reason for supposing that some insects, at any rate, take as the main guide to any particular series of movements the direction of greatest light; some species of insects now immolate them-

selves actually by millions on the electric lights established in some of the small towns of America. Forel's experiments on varnishing the eyes of insects also seem to point to the probability that perception of the direction of light is a main factor in guiding movement. Diptera, whose compound-eyes he covered with an impenetrable varnish, did not, when first released, direct their movements in any definite direction, but ended by flying straight up in the air quite out of sight, —that is, in the direction in which they would still perceive light by their ocelli or simple eyes.

If the direction of some particular light, or amount of light, play the part of a mariner's compass in guiding each flight of an insect, and if it possess an accurate perception of lights and shades by means of its facets,—that is, perceive the direction in which some shade cast on its eye is most intense, and that in which it is least intense,—it could avoid an object perfectly, although never perceiving anything more than a part of the shadow affecting the optic organ, and by which the source of light was partially, or more or less completely, eclipsed. To a creature of this kind refractions of light will be most important, and one of the most pressing series of considerations about the compound-eye will be its properties as a set of refracting instruments.

The multiplicity of facets must clearly be a great advantage in the perception of movement. Between the insect's eye and some set of rays of light a shade commences to appear; at the first moment one set of facets is affected, at the next instant adjoining facets are occupied; surely not only may a movement make itself thus felt by the ocular organ, but also the direction of the movement may be determined. I have already said that Exner advocates the seeing of movement as one of the functions of the insect's eye. Patten has criticised in an unfavourable manner Exner's views as to the perception of motion, but I cannot myself see the force of his arguments, if it be understood that it is not the lights and shades of a retinal picture that are affected; the whole ommatidia* are, as I put it, in equilibrium with the amount of light falling on them, and each may have a separate perception of a change in this amount.

* The ommateum of recent anatomists.

Before quitting the subject of vision, I must say a few words, if only by way of recognition and admiration, as to the work that has been done at the compound-eye by anatomists. There is, perhaps, no object more difficult to investigate minutely by the aid of the microscope than the compound-eye of an insect. I need not refer in detail to the difficulties, for you all no doubt have some idea of them. These difficulties have, however, been to a considerable extent overcome by the skilful application of the great resources of modern microscopy. Grenacher, Hickson, Lowne, and Patten have published descriptive memoirs on the subject, accompanied by plates that are of the greatest value to entomologists, who, like myself and many of you, have neither time nor skill for personal research in such ways. But there still remains much to be done; indeed, the structure of each ommatidium,—that is, the part behind and connected with each facet,—is very complex. The details I shall not attempt to allude to, but there are certain points that have a special bearing on the functions of the organ, or aggregate of organs, that I may briefly mention. In the first place, they have detected nothing that can be looked on as an apparatus at all suitable for the formation and perception of a continuous picture. The percipient parts of the nervous portions of the organ are, indeed, the parts about which there is most discrepancy in their views. Grenacher considered certain parts that he called retinulæ, in connection with the rods, to be the percipient portions of the eye; but they are so different from the retina and membrana jacobi of our own eye, that they must have a very different function. Lowne rejected Grenacher's view, and considered that a dense nervous structure that he styled bacilla, with the parts behind it, are the true—indeed the sole—percipient part of the eye, and he gave a figure showing the manner in which he supposed a picture was formed on this retina. Hickson followed with a memoir investigating more particularly the nervous structures in the more interior part of the eye, or, to speak more correctly, lying between the eye proper and the optic ganglion: these structures he found to be most wonderfully complex; he rejected Lowne's view as to the parts immediately behind

the basilar membrane being a retina or commencement of the percipient portions of the eye, and called the parts in question the terminal anastomoses and the periopticon; he also re-affirmed very strongly as correct the views of Grenacher and the numerous authors who had agreed with him, that the retinulæ are the percipient parts. Patten has more recently made an investigation of the structure of the ommatidium, and states a totally different view; he locates, in a most positive manner, the seat of perception in the crystalline cones, a view which had been asserted by one or two earlier authorities, but had been almost abandoned. Thus, then, we have the latest three authorities locating the seat of vision in three totally different parts of the eye.

It is not my province, even if I were capable of doing so, to attempt to determine how much value there is to be attached to all or either of these views; but I will just recall the fact that the compound-eye, speaking roughly, may be divided into three parts: 1, the outer part consisting of the structures from the outer facets to the apices of the crystalline cones; 2, the intermediate structures between the cones and the basilar membrane: and 3, the structures within the basilar membrane. Now, the authorities I have mentioned are confident that a percipient layer exists in each of these different zones. It is clear, then, that the function of the compound-eye cannot at present be determined by anatomical knowledge, but that it is probable that the functions of the eye may be complex,—indeed, that there may actually be two or three different sets of perceptive structures. It is true that each of the anatomists I have named is pretty confident as to the correctness of his own view, but I am inclined to think that it is possible that neither of them has given sufficient attention to the idea that the existence of one percipient layer does not necessarily prove the non-existence of another. Whether this prove to be the case or not, it is quite certain that the nervous structures in connection with the compound-eye are most remarkably perfect and complex. Hickson does not hesitate to express his admiration of their extent, and it is evident that the number and variety of the nervous structures of the insect's eye are not the least amongst

the factors that make comprehension of its function so difficult.

Anatomical knowledge, then, like the other methods of inquiry, tells us that at present we know very little about how or what an insect sees. It is highly probable that its sight is very different from our own, and that continuous picture-vision forms no part of it; while it appears to be even possible that the compound-eye may have two or three distinct kinds of perception. There is every reason for supposing that the ocular powers of insects are very perfect in their way, although that way may be very different from ours. Indeed, it would seem to be quite possible, if not probable, that a company of gnats dancing in the rays glinting through the bushes on a summer evening or in the afternoon of an autumnal day, may by means of acute perceptions of lights and shades be enjoying an ocular treat as varied and as exhilarating to them as the prospect we enjoy from the summit of Righi or Pilatus is to us; while at the same moment, by means of an extreme sensitiveness to movement and its direction, they may be taking part in a rhythmical concert of no mean order of excellence.

I have devoted so much time to the consideration of the sense of sight, that I must not attempt to discuss the other senses at any considerable length. Probably the one next in importance to insects is that of smell. The earlier naturalists began trying to understand the sense of smell in insects by supposing it to be similar to our own. In the Vertebrata the organs of smell are invariably placed in connection with their respiratory organs, a free current of air through the olfactory organs being absolutely essential. This being known, a habitat for the sense of smell in insects was sought at the commencement of the air-passages, especially in the stigmata; this, however, has now been nearly abandoned, chiefly because no adequate nervous structures have been detected there; and the sense of smell in insects is now thought to be located in the antennæ or in some of the parts of the mouth. Investigation has revealed a number of remarkable minute structures in the antennæ that are pretty certainly sense-organs, but to what extent they can properly be called

organs of smell is still doubtful. One point, however, is clear, namely, that if the organs I have alluded to are really for olfactory purposes, their functions must be exercised in a very different way from that in which we smell. For instance, it is difficult to imagine that any sense of smell can exist without the passage of air over the sensitive surface, for the minute particles of some odorous substances must be extremely rare; hence, as there is in ordinary circumstances no such current of air in contact with the antennæ of insects, it would seem that their functions in many cases can only be exercised fully when the insect is moving rapidly through the air: at least so far as contact with odorous particles goes it *could* be effected in this manner; so that we are brought to the strange conclusion that an insect may smell acutely when it is flying through the air, and be unable to perceive the same odours when it is quiescent. In another respect the insect antennæ may be superior to our olfactory organs, for these latter can only smell odorous substances when these are in a dynamical state, that is when their particles are being or have been recently dispersed; but it is quite conceivable, nay probable, that many substances only disperse their odorous particles under certain circumstances, and yet the odorous particles are there; well, in such a case it is possible that the insect can still perceive the smell, though to us there is none, for the insect can go to the object and lay its olfactory organ on the quiescent odours and so detect them. But I must not detain you by speaking at greater length on this point. The knowledge of insect olfactory organs is even more primitive and uncertain than that of their optic organs, and you will therefore readily understand that improved knowledge on this point may quite change our views as to some of the phenomena of insect life.

In regard to the other senses I must content myself with the assertion that we know very little about them. The sense of touch insects can scarcely be considered to possess at all, owing to the fact that their skeleton is external; nevertheless these creatures undoubtedly receive some tactile impressions by means of setæ, or structures approximating to setæ, whose bases pass more or less completely through the

insensitive external layers of the body, and are in contact with the nervous system in the interior. Of the senses of hearing and tasting we know remarkably little, though some good work has been done at them recently. I cannot, however, quit this part of my subject, without reminding you of the very interesting chapter in Sir John Lubbock's book 'On the Senses of Animals,' in which he deals with the question of unknown senses. If there should be any of you who have not read it, I should advise you to repair the omission as soon as possible.

There is perhaps no word in the English language more vague in meaning than "instinct": it is used with a variety of meanings attached to it, and frequently with almost no meaning at all. It is used by some to indicate their impressions as to the nature of the mental processes in insects or other animals; by some, as that condition which in animals replaces our own reason; while others use it simply as a term to be applied to a series of animal actions; others impersonify it and give it an objective existence, as when they say, "instinct teaches them"; and yet again, the word is in use by scientific men to indicate a certain limited class of our own actions. This latter is its primary use, and it ought also to be its sole use. The application of the word in Entomology gives rise to a great deal of confusion. I am not aware, however, that any terms have yet been proposed to replace it, and I shall to-night use it as meaning "some connected series of insect actions."

There seems to be a widely spread impression, to the effect that instinct cannot be accounted for by any theory of evolution.

M. Fabre has published, at intervals, three volumes of studies on the habits and instincts of insects: the second volume of the series was noticed at considerable length by Sir John Lubbock, in his presidential address to this Society eight years ago, and a third volume has been since published by the talented French naturalist. As an observer of the habits of insects, M. Fabre stands, I think, *facile princeps* in our generation: in literary ability he has never been surpassed, and rarely equalled by any writer on Entomology:

the patience and ingenuity he has displayed in his investigations, and the brilliant style in which he has described the latter, can be only understood by his readers. Undoubtedly his recent volume is a most valuable addition to entomological literature. M. Fabre considers that his observations on instinct shew it to be quite irreconcilable with the modern theory of organic evolution, and constantly expresses this opinion in the most frank manner. Still I am of opinion that he has completely failed to establish this view.

Undoubtedly there is very much that we cannot yet understand in insect instinct. This is due, I believe, in part, to our complete ignorance of the nature of their senses, and in part also to the fact that we do not sufficiently realise the profound differences that exist between the most fundamental of the vital functions of insects and those of the Vertebrata, including ourselves. The most important of the peculiarities of instinct are, perhaps, its limited range of adaptability, that is the small amount of variability according to circumstances, and its perfection within its own limits. Lubbock has already, if I recollect right, suggested that these characteristics are probably a consequence or correlative of the short life of the individual insect, and I think it is possible to get a glimpse, although a very imperfect one, of the ways in which they may have been evoluted. If it is shown that the abbreviation of the individual life of the insect may have been conducive to the preservation of the race, and that the peculiarities of their instinct may be consequential to, or correlative with the short life-cycle, I think that is all that evolutionists need require at present.

That the abbreviation of the life-cycle may be an advantage is shown by the case of the flesh-feeding *Muscidæ*; the competition in nature for flesh-food is so severe, ranging from micro-organisms to carnivorous mammalia, that it is perfectly certain that a larva of a *Sarcophaga* that can eat enough in two days to serve the purposes of its metamorphosis, must have a great advantage over those that are slower; this is so evident, that it is unnecessary to dwell on it. But it may be said that this is an exceptional case; and it certainly is so; but there are other considerations which show us that

abbreviation of the larval period may be of service: for instance, an army of caterpillars will have a great advantage if their period of feeding can be reduced, so that the eggs shall only require to be deposited when there is plenty of food ready for them, and yet their life shall not extend into the period when vegetation fails in vigour; clearly, too, defenceless caterpillars, without means of escaping from their numerous enemies, had better make this stage as short as possible. I think it will not be altogether lost time if we pursue this analysis a little farther: for if we do so I believe we shall find that abbreviation of the larval stage is to some extent connected with abbreviation of the duration of existence in the perfect state. In order to make this clear, I must briefly recall to you the conditions under which the great functions of life are exercised in insects. In them the functions of growth and development are more completely separated in time than they are in the Vertebrata, and are more sharply divided from the period of reproduction: this is no doubt associated with—is possibly a specialization resulting from — certain remarkable peculiarities in their function of nutrition. In the Vertebrata waste and repair of the tissues are carried on by means of a single medium, the blood, which takes to the tissues at each moment, in the form of oxygen, the means for exercising function, that is deteriorating themselves, and the means for repairing that deterioration; hence tear and repair go on *pari passu.* In the insect it is not so: the function of oxygenation is carried on by a separate medium, unconnected with the circulation of the blood; hence waste can be carried on without repair. Turning now to the means of circulation of the blood, this is undoubtedly the weak point of the insect economy: there is no system for carrying the blood minutely into the tissues, and we have in the insect the curious phenomenon of indirect assimilation and the accumulation of unformed tissue to an enormous extent. These characters permit the phenomena of growth and development to be much separated, without being altogether independent. In the larval stage the tracheal system is less developed, and the accumulation of unformed tissue is carried to a most extraordinary extent; in

this stage of life the insect is to a considerable extent an organism for the accumulation of property in the shape of unformed tissue: this unformed tissue is in the stage devoted specially to development,—the pupal stage,—partly changed into the structures of the perfect insect, but in part carried over in the shape of still unformed tissue for the advantage of the final or reproductive period. But in the final stage of existence there is found a great change in the balance of the grand functions of life. There is a great demand on the organism by the function of reproduction; the activity of the individual is much greater, the tracheal system facilitating deterioration of the tissues is largely developed, while on the other hand, not only is there no corresponding improvement in the modes for repairing waste, but there is an actual diminution of activity in this respect: many insects take little or no food while in the perfect condition, and it is probable that few take anything like enough to compensate for the great drain on the system during this stage, and they carry on the vital functions probably very largely by the aid of the unformed tissue they acquired during the earlier stage.

This very rough and imperfect sketch enables us, I think, to see that there may be direct relation between the lengths of the stages of the insect's life. It will be in some respects, as we have previously seen, a disadvantage for the larval stage to be prolonged, but if the activity of the final stage is to be great, it is requisite that the larval stage should be sufficiently prolonged to allow of a large quantity of unformed material being carried over to the final stage; thus the strange paradox is established that limiting the activity in the final stage of the insect's existence, other things being equal, will permit of the larva doing with a less amount of food,—that is, will allow it to shorten its period of existence. Now, is it not unreasonable to expect that under such circumstances, during a long series of generations, an organism shall have developed any unnecessary variety of action? Perfection within a limited range is what will be favourable to the continuance of the species. And this is the dominant feature of insect-instinct.

I am well aware that the above sketch is extremely imperfect, and that the actual facts are enormously more complex than I have put them, and that there are other things that ought to be taken into consideration: but I am also aware that there are conditions that tend to intensify the action of the factors I have mentioned.

M. Fabre has devoted one chapter of his delightful work on the habits of Hymenoptera to a special argument against transformism, and gives it the rather witty heading, "a sting for transformism." I have not been able to gather very distinctly from his writings what he means by transformism; but in the chapter I am alluding to his argument leaves no doubt at all that he is referring to the theory of descent of several existing species from a common ancestor. I have myself elsewhere stated that I am inclined to think that theory will prove to be to a great extent erroneous, and have given reasons for my opinion; I should therefore have gladly welcomed M. Fabre's support, if I found it possible to accept his argument as good, but, I regret to say, I fear it is likely to prove invalid: it amounts briefly to this, that if several species of *Scolia* that now feed their young each with a different and distinct kind of insect-food are descended from a common ancestor, then that ancestor must have been in the habit of feeding its young, not with some particular species of insect-food, but with a variety of kinds; and, if this was the habit of the original *Scolia*, M. Fabre urges that its offspring could never have abandoned this advantageous course of living, which he calls "*régime varié*," for the habit of living on a single species, or "meals of a single dish," as he styles it. The basis of this argument is that *régime varié* is a great advantage to the insect; if it is not, then M. Fabre's argument fails completely,—the sting proves to be without point or venom. He cites instances to show that *régime varié* is an advantage, but every one of them is taken from the Vertebrate class. Now, it may be highly probable that *regime vawié* is an advantage in the case of Vertebrata, but is it so in the case of insects? I fear we must say probably it is not: in the first place, it is comparatively rare among insects, one of their peculiarities being their extreme

specialisation in the matter of variety of food; and, in the next place, the function of nutrition shows a most important difference in insects and in Vertebrata. Immediate perfection of tissue-assimilation is the point of importance in the nutrition of Vertebrata, and for this *régime varié* is, on the whole, probably favourable. But in insects in the larva-stage, tissue-assimilation is subordinate in importance to the accumulation of unformed tissue for the purposes of a future stage: is it not probable that "meat from a single dish" may be favourable to this curious and imperfect form of assimilation? If so, M. Fabre's argument, instead of shaking the theory of common descent, actually helps to support it. But whether this be the case or not, it is at least certain that the hypothesis on which M. Fabre bases his argument is a very doubtful one, for there may be,—indeed, I think there are,—other reasons for supposing that meat from a single dish may be more advantageous to the insect larva than *régime varié*.

I must now briefly apologise to you for the imperfect manner in which I have treated the great subject I have been discussing. Insect-instinct, indeed, is one of the most difficult problems that the biology of the future will have to deal with, and it must be very long before we can pronounce any very positive opinion as to whether it is favourable or unfavourable to the theory of evolution. To many it no doubt may seem unsatisfactory that we should have discussions on discussions and never come to a positive conclusion on any important point. Nevertheless, the subject is undoubtedly somewhat advanced by such means, and the fact that a long time must elapse before a clear comprehension can be attained is no sufficient reason for abandoning the attempt to comprehend. The value of such societies as ours consists, indeed, partly in the fact that they facilitate the extension of discussion beyond the period of a single life, and their existence is to some extent a guarantee that any efforts we may make towards the elucidation of difficult subjects will not be thrown away.

It now only remains for me to thank you, gentlemen, for the unvarying consideration you have exercised towards me during the period of my presidency, and most cordially to

congratulate you on your ratification of the choice the Council has made of my successor in the Chair. Lord Walsingham is well known to you, and you all know, too, that it is but rarely the Society can expect to find one so well qualified by social position, by natural disposition, and by entomological attainments for its president. We may feel confident that under his presidency the Society will continue to flourish.

APPENDIX.

MEMOIR OF GEORGE ROBERT WATERHOUSE.

BY HIS SON

CHARLES OWEN WATERHOUSE.

George Robert Waterhouse was born at Somers Town on March 6th, 1810. When a child he appears to have had a fancy for straying from home, and an advertisement for his recovery on one of these occasions (when he was two years old) is still in the possession of his family. This fancy had an important bearing on his after life, as on one occasion he was found by a Mr. Irwin, who thus became acquainted with his father, and later on (in 1821) advised his being sent to a school at Kœkelberg, near Brussels, close to which Mr. Irwin had a house. Whatever may have been the character of the education received (and in one of his early letters he complains greatly of his school, styling it a prison—"a prison I may justly call it, as we have eleven hours' class in a day"), there is no doubt that the knowledge of French acquired was of the greatest service to him in his after life as a naturalist, in his frequent visits to Paris, and in his voluminous correspondence and constant intercourse with French naturalists who visited him, to whom he was always ready to offer every hospitality and any assistance in his power.

A taste for Entomology (inherited from his father, who was a lepidopterist), developed itself at an early age; and in a note-book, in which he recorded incidents of his life, he mentions the indelible impression made on his mind by the capture of a pair of poplar hawk-moths on some trees in a nurseryman's garden (a spot now occupied by New St. Pancras Church), which was opposite to the house in which he then lived. Being a child, he placed them in a bird-cage. In a letter dated

May, 1824, from Kœkelberg, he writes to his father:—"I have not got many moths as yet, but luckily a great many beetles. I hope to get more moths as the season advances. I shall want more cork, pins, and another large box, with as many small ones as you can send."

Almost immediately after this, however, he returned to England, and was articled to an architect, but devoted his spare time to the study of Natural History. He appears only to have followed this profession between the years 1831—1835; the only recorded works being the building of a house in King's Road, Chelsea, the laying out of Charles Knight's garden in the Vale of Health, Hampstead, and the designing of the ornamentation of St. Dunstan's Church. No doubt his training as an architect was of value to him as a naturalist; his eye, accustomed to designing ornaments, at which he was very skilful, enabled him to notice and appreciate differences in form in insects, &c. He was also able to make his own drawings, several of his papers being illustrated by himself. It is not unlikely, moreover, that the "nervous striving at scientific accuracy in all his writings," which has been noticed as one of his peculiarities by one writer, may have arisen from the same cause.

In his note-book, already referred to, he has an entry under the year 1833 as follows:—"The great event of "this year, to me, was the establishment of the Entomo-"logical Society. Talking about entomological subjects "at home one evening, my father said, 'Why do not you "entomologists form a society?' Full of the idea, I went "to Mr. Hope next day (I saw him almost daily at this "time, and, indeed, arranged his collection of British "Coleoptera for him), and told him of my father's "suggestion. The idea pleased him, and he immediately "communicated with some of the leading entomologists. "A meeting was called at the 'Thatched House,' St. "James's Street, soon afterwards (May 22nd, 1833), "and the Society was then established, and I was elected "honorary curator."

For a long time he was engaged in writing articles on mammals, fishes, and insects in Knight's 'Penny Cyclopedia.'

In 1835 he accepted the appointment of Curator to the Museum of the Royal Institute at Liverpool, which

appointment he exchanged, in 1836, for the Curatorship of the Zoological Society of London. He commenced at once to make a catalogue of the mammals in that Society's Museum, and by the spring of 1837 had completed it. The catalogue, however, was not published until the next year, owing to his having introduced into it his own classification, which met with strong opposition from those who considered it better to keep to the quinary system, then much in vogue, and according to which the Museum collection had previously been arranged. About this time he wrote the volume on Marsupials in Sir W. Jardine's 'Naturalist's Library.'

My father was invited to accompany Mr. Charles Darwin on the expedition of H. M. S. 'Beagle,' but was unable to do so; and Mr. Darwin, on his return to England, placed the mammals and coleopterous insects in my father's hands to work out. An account of the mammals was published as an Appendix to 'The Voyage of the Beagle.' Several papers, chiefly on *Carabidæ* and Rhyncophora, were published in the 'Magazine of Natural History,' as well as an account of the interesting series collected in the Galapagos Islands.

It is not generally known that he devoted much time to the study of the Heteromerous Coleoptera, and made out a scheme for their classification. He had prepared a paper for publication, and proceeded to the Entomological Society to read it, but unfortunately it dropped from his pocket and was lost, and he never had the heart to re-write it. Some of the chief points used in the classification were fortunately noted elsewhere,* and have since been taken up by Lacordaire in his 'Généra des Coleoptères.' The dissections which he made for the purpose are now in the British Museum. It is not improbable that the examination of the Heteromera was mainly due to the study of the new genera and species collected by Mr. Darwin, particularly those from the Galapagos Islands, and the *Nyctelidæ*. An account of these latter was published in the 'Proceedings of the Zoological Society,' and others in the 'Ann. & Mag. of Natural History'; but many more already dissected and some named in manuscript show that he had given much attention to them.

* See Ann. & Mag. Nat. Hist., xvi. (1845), pp. 317, 318.

In November, 1843, he was appointed an Assistant in the Department of Mineralogy and Geology in the British Museum. In 1844 he commenced his work on the 'Natural History of Mammalia,' which occupied all his available spare time until 1848, when, chiefly owing to the outbreak of the French Revolution, the publisher, Mr. Hippolyle Baillière, was unable to continue the work. According to the agreement made with the publisher, the work was to have been completed in three volumes ; a task which it would have been impossible to fulfil without greatly curtailing the descriptions in the third volume. The two volumes which were completed, containing the account of the Marsupials and Rodents, would have been sufficient to establish my father's reputation as a naturalist. It is perhaps not too much to say that the work has never been surpassed, and it holds its place as one of the most valuable contributions to the knowledge of the mammals.

He was President of the Entomological Society for the years 1849 and 1850, and in this latter year he was elected an Honorary Fellow of the Zoological Society in recognition of his services as a zoologist. In 1851 he was appointed "Keeper of the Mineralogical Branch of the Natural History Department" in the British Museum, the fossils being at that time associated with and subordinate to the minerals.

In 1852 his youngest brother, Mr. F. G. Waterhouse, went to S. Australia, where he afterwards became Curator of the South Australian Institute Museum at Adelaide. At this time the Coleoptera of South Australia were not much known, and Mr. F. G. Waterhouse spent much time in collecting them. Collections were sent home from time to time in tin canisters, the insects being arranged in layers between pieces of linen, and in this way they arrived, for the most part, in excellent condition. Much of my father's leisure was at this time occupied in mounting the specimens he received in this way. As the tins were opened, the specimens were laid on damp blotting-paper on a plate covered with a bell-glass, and placed near the fire, by which means they were rapidly relaxed so that they might be pinned with safety. At this work, when a fresh consignment arrived, he sometimes sat till the small hours of the morning. These collections, moreover, naturally led him to the

study of the Australian Coleoptera, particularly the Rhyncophora, and he described several new genera and species, besides writing a monograph of the family *Amycteridæ*. Among his note-books was found a manuscript catalogue of all the described Australian Coleoptera known to him, which must have taken much time to compile.

In 1855 he prepared an article on the geographical distribution of Rodents for Keith Johnston's 'Physical Atlas.' In 1858 he was sent by the Trustees to Germany to examine a collection of fossils offered to the Museum. This collection he immediately recommended them to purchase, as it contained the remarkable "Archeopteryx," which he thus succeeded in acquiring for the Museum. Having taken with him a considerable number of British Coleoptera which were difficult of determination, he was able to compare them with the specimens in the Berlin Museum, which he visited on his return journey. He also had an opportunity of seeing some parts at least of Dr. Kraatz's collection; his note-book contains particularly memoranda of the *Aleocharidæ*. A number of Malacoderms he left with Dr. Kiesenwetter, who kindly named them and sent them to him afterwards. This work was done with a view to his Catalogue of British Coleoptera, which at this time was commenced. To this Catalogue, which gave such an impetus to the study of this order of insects among English entomologists, he gave all his energy for the following years until 1861. Those who have taken up the study of British Coleoptera only of late years, can scarcely realise the difficulties which beset the coleopterist before the publication of this Catalogue. The difficulty also of preparing the Catalogue itself will be imagined when we remember that some of the best works on European Coleoptera, which we now use, and which would have been of such valuable assistance, were then not published. The nomenclature in vogue in England was greatly at variance with that used by continental coleopterists, and even the continental nomenclature was in a less satisfactory state than we now see it.

Stephens' 'Manual' and that author's collection were supreme in England. The first and not the least difficult task was to examine and decide upon the value of the multitude of this author's so-called species; and, in the Brachelytra especially, to identify Kirby's species. But

first of all a collection had to be formed of the smaller insects, such as *Homalota*, *Oxypoda*, *Atomaria*, *Cercyon*, *Cryptophagus*, *Pselaphidæ*, &c., enormous numbers of which had to be collected and set in order to ascertain how many species might properly be considered British; the great stumbling-block to be got over was *Homalota*, and for a long time he devoted himself most perseveringly to this genus, every locality within his reach likely to yield additional species being visited. When collecting he made a rule of not remaining in one spot (unless he was looking for some particular species), but divided his time first to moss, then roots of grass, dead leaves, bark of trees, heaps of rubbish, hay-stacks, wood-stacks, &c., his object being to secure as many species as possible, rather than long series of a few species. Every specimen mounted was marked with a number corresponding with his register, in which the date and place of capture, and any circumstance of interest, were noted, the names of the rarer species often being added. In his first List of *Aleocharidæ* ('Zoologist,' June, 1857), he states that all the species not marked with an asterisk were taken by himself in the two preceding years. Of the eighty-one *Homalotæ*, only nine are so marked.

Besides the works already alluded to, he was the author of some 120 articles in various scientific journals. After the completion of the Catalogue of British Coleoptera he gave comparatively little attention to Entomology, partly on account of his eyesight, which had been somewhat injured by the constant examination of small species, and partly because he had been led by a friend to take up some literary researches.

In his official capacity in the Museum, he was much engaged in the preparation for the removal to South Kensington of the geological collections, which since 1857 had been separated from the minerals. The examination of the plan of the new museum soon convinced him that the space allotted to him was inadequate for the increasing collections, and by his advice, which his early training as an architect qualified him to give, the building was considerably altered so as to give increased accommodation for the collections in the gallery now occupied by the Reptilian remains. The general arrangement, and the position of all the larger specimens in the new building, is now much as he

planned it. This work harassed him much, and, feeling unequal to the anxiety of the approaching removal, he resigned his appointment in 1880, after thirty-seven years' service. Although, in his official position, he was a paleontologist, he never published any works on this subject, but devoted himself to the very necessary, but unobtrusive, work of arranging the collections under his charge, and, when he became Keeper, to the superintendence of his department. He was always most enthusiastic in the acquisition of interesting new forms for the Museum collection, and, out of his family, few persons, except those immediately around him, knew of the great pains he exercised in considering the best way of utilising the grant at his disposal for the purchase of specimens, and the care that he took in selecting from collections offered to the Museum. And, although it does not appear that the Trustees ever refused to purchase any collection which he recommended, he often manifested great anxiety while waiting to know their decision when any important collection was before them.

In 1885 he had a paralytic stroke, from which he never entirely recovered, and he died on January 21st, 1888, in his 78th year.

With reference to his private life, it is only needful to mention that in 1834 he married a daughter of Mr. G. L. J. Griesbach, of Windsor, and sister of the Rev. A. W. Griesbach, whose name appears in the list of the first Council of the Entomological Society. He left three sons and three daughters. The second daughter married the late Mr. E. C. Rye, the well-known author of 'Rye's British Beetles,' in the preparation of which work Mr. Rye had the benefit of my father's advice and assistance.

My father's collections were at one time extensive, although he professed to restrict himself to genera so far as the exotic Coleoptera were concerned, except in a few groups in which he was particularly interested. When he removed from the Museum, on his retirement in 1880, he disposed of all these collections, after having presented to the Museum all his actual types. His collections of British Coleoptera and Hymenoptera remain in the possession of his sons.

CHAS. O. WATERHOUSE.

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NOTE.—Where the name only of an Insect or Genus is mentioned, the description will be found on the page referred to.

The Arabic Figures refer to the pages of the 'Transactions'; the Roman Numerals to the pages of the 'Proceedings.'

GENERAL SUBJECTS.

ARACHNIDA.

COLEOPTERA.

DIPTERA.

HEMIPTERA.

HYMENOPTERA.

LEPIDOPTERA.

NEUROPTERA.

ORTHOPTERA.

WEST, NEWMAN & CO., PRINTERS, HATTON GARDEN, LONDON, E.C.

Date of issue.	Date of issue.	Date of issue.